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A SYSTEMS ANALYSIS APPROACH TO DECISIONMAKING IN A NON-APPROPRIATED FUND ACTIVITY

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THESIS

A SYSTEMS ANALYSIS APPROACH TO DECISIONMAKING
IN A NON-APPROPRIATED FUND ACTIVITY

by

Stanley Frank Bloyer

March 1975

Thesis Advisor: Dan C. Boger

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A Systems Analysis Approach to Decisionmaking in a Non-appropriated Fund Activity

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requirements for the degree of

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I. INTRODUCTION

A. DESCRIPTION OF NON-APPROPRIATED FUNDS

Military base commanders obtain funds to conduct their activities from two sources: Appropriated Funds and Non-appropriated Funds.

Appropriated Funds are provided by the Congress. They consist primarily of Operations and Maintenance (O&M) funds which are intended for support of mission essential activities such as training. A small portion of Appropriated Funds is designated for support of the various morale- and retention-enhancing services which exist at every base, but the amounts are insufficient to support the level of these services which is customarily provided.

Non-appropriated Funds are broken down into two further categories: Central Welfare Funds and Base Welfare Funds.

Central Welfare Funds are obtained from the profits of the military exchange systems. These funds are distributed to base commanders to support gymnasiums, hobby shops, swimming pools, and other welfare and recreational activities which are routinely used by all personnel.

Base Welfare Funds are generated by the activities of clubs organized to serve various special interest groups. These organizations include officer and enlisted clubs, audio clubs, photography clubs, rod and gun clubs, flying clubs, etc., and are generally referred to as Non-appropriated Funds.

Although no definitive figures exist, a recent (1973) survey indicated that there were some 17,000 Non-appropriated Funds operating throughout the Department of Defense, generating about $7 billion in sales [Ref. 1]. While it should come as no great surprise to anyone familiar with officer and enlisted clubs that these activities could generate a considerable dollar volume, estimates of $5.6 million in sales by fifty-five rod and gun clubs, and $43 million in sales by thirty audio clubs [Ref. 2] may prove somewhat astonishing. It becomes clear why the exchanges periodically voice complaints about sales lost to Non-appropriated Funds. It also becomes clear why the (fortunately infrequent) revelations of embezzlement and other irregularities in Non-appropriated Funds arouse so much concern in Congress and DOD about alleged lack of supervision and control of these activities, and the substantial monies they generate.

Almost all Non-appropriated Funds are directed by a board of governors or some similar body which is usually elected by the membership. In addition, a custodian, who must be a member on active duty, is appointed as a non-voting member of the board by the base commander. The custodian is accountable for the physical assets of the Fund, and is tasked with keeping the base commander (who bears the ultimate responsibility for proper operation of the Fund) informed of the progress of the organization. A full-time manager, as well as other employees, may be employed, depending on the scope of day-to-day operations.

The financial and other problems which seem endemic among Non-appropriated Funds stem directly from two characteristics which are universal and interactive.

The first characteristic is non-professional management. More often than not, election to the board of governors is dependent upon time available to serve and popularity among the membership, rather than managerial expertise. Even if the membership is astute enough to elect a capable board, the turnover imposed by normal transfers ensures that long-term planning and follow-up will be difficult to accomplish.

The second characteristic is that goods and services are provided at prices which are lower than those available elsewhere. The reduced prices arise from several factors. Non-appropriated Funds are operated on a not-for-profit basis. The use of surplus government equipment and rent-free government facilities minimize capital requirements and overhead. The practice of employing military retirees or "moonlighting" active duty personnel at relatively low pay scales contributes to reduced costs for labor and day-to-day management. Unfortunately, at the low wage rates required to keep costs down, it is difficult to attract employees with sufficient training or ability to offset the managerial shortcomings of the typical board. Thus Non-appropriated Funds, by their very nature, are vulnerable to severe management difficulties.

B. DESCRIPTION OF SYSTEMS ANALYSIS

Systems analysis is an approach to, or a way of looking at, complex problems of choice, usually under conditions

of uncertainty. It offers a framework for inquiry which is designed to aid decisionmakers in selecting preferred future courses of action. The framework is built upon systematic search for relevant objectives and alternate means of achieving them, and quantitative comparison of the costs, benefits, and risks involved in the identified alternatives [Ref. 3].

Systems analysis usually involves the following phases:

Formulation - Entailing specification of the boundaries and issues of a problem, as well as the criteria for choice.

Search - Involving the accumulation of data and the development of hypotheses concerning relationships which bear on the problem under investigation.

Evaluation - Encompassing the construction of models (usually quantitative) which identify the consequences of alternatives and allow comparison based on the consequences.

Interpretation - Collating the alternatives generated in the evaluation phase with any other relevant information in order to extract conclusions and fix courses of action.

Verification - Testing the conclusions, if testing is possible.

Of these phases, the first is the most important. Obviously, the right answer to the wrong problem is of little value. In fact, the criticality of the formulation stage often leads to an iterative process of investigation. Evaluation and interpretation of data and relationships developed in the search phase may expose errors in definition which require reformulation and repetition of the entire process.

With regard to models, it is important to bear in mind that their main purpose is to develop meaningful relationships between the costs and benefits of various objectives and alternatives. They need not be highly mathematical or

computerized, but they should emphasize factors which are most relevant to the problem under consideration, while moderating items of lesser import. Lastly, since models are by definition only a representation of the true state of the world, they must include both provision for dealing with uncertainty and explicit delineation of the assumptions on which they rest [Ref. 3].

Systems analysis is an art founded upon the discipline and logic of mathematics and the scientific method. Conceived in the murky complexities of long-term military planning, it has emerged from the "puzzle palaces" of the Department of Defense to become an important tool for planners in industry and many other endeavors. The fact that it was developed to cope with huge problems over future decades should not preclude the effective employment of its fundamental concepts in planning for a fortnight. Of course, the principle holds that, while in the long run nothing is fixed, in the short run everything may be. Thus the number of feasible alternatives is likely to be inversely proportional to the planning horizon. For organizations which historically have found it difficult to employ the most rudimentary forms of planning, the elements of systems analysis should prove eminently useful even though planning horizons may be short and choices limited.

C. OBJECTIVE

As discussed in the preceding section, systems analysis has evolved as a valuable method for assisting decisionmakers in dealing with highly complex problems of immense magnitude.

It seems reasonable that the systems analysis approach to problem solving should prove equally useful regardless of the scope of the activity or project to be analyzed. The objective of this thesis is to demonstrate the utility of systems analysis when applied to the more mundane problems of organizations which comprise a relatively small, but nonetheless important portion of DOD activity: Non-appropriated Funds.

D. SCOPE

Research for this paper involved an investigation of library resources, both published and unpublished, pertaining to Non-appropriated Funds. Several standard texts on systems analysis and operations research provided material for the introductory and applications sections. The operational and financial data of the Non-appropriated Fund used as an example were extracted from historical records of the organization and interviews with knowledgeable members.

E. METHODOLOGY

Following a brief description and history of the Non-appropriated Fund used as an example, selected major problems of the organization are identified. Each problem is then analyzed with emphasis on the systems analysis techniques employed.

II. SYSTEMS ANALYSIS APPLIED

A. BACKGROUND

The Fort Ord Flying Club is a Non-appropriated Fund which provides opportunities for recreational flying and advanced flight training to active duty and retired military personnel, and federal employees in the vicinity of Fort Ord, California. The following historical information was provided by a long-standing member [Ref. 4].

The Fort Ord Flying Club was organized by about 30 members in 1956 or 1957. It began operations with one surplus Army observation aircraft (a two-passenger Piper J-3 Cub variant), two surplus Ryan Navions (four-passenger, single-engine, retractable gear) and a Cessna 172 (four-passenger, single-engine, fixed gear). The club aircraft were based at Monarch Aviation, Inc., a fixed base operator located on the Monterey Peninsula Airport. Operation from the civilian facility was forced by the unwillingness of the commander of Fritzsche Army Airfield, which is located adjacent to the Fort Ord complex, to grant permission for the club to operate from his facility. The non-flying activities of the club were conducted in facilities made available on the main post.

By 1966, the club had grown to about 45 members. It had two two-place Cessna 150 trainers and a Cessna 172. At about this time the club was invited by a more sympathetic airfield commander to move its entire operation to Fritzsche Field.

Among several advantages proffered to induce the club to move, the most significant were the promise of office space and meeting facilities in the airfield hangars, and access to aviation fuel at military contract prices.

The club elected to move to Fritzsche. One of the consequences of the change in location was that the maintenance services of Monarch Aviation were no longer convenient. Arrangements were made for necessary maintenance to be performed on a part-time basis by appropriately licensed Army aircraft mechanics.

Not long after the move to Fritzsche, the club hired its first full-time manager/flight instructor. The new manager undertook an ambitious expansion program. Under his guidance, the club acquired several surplus aircraft, and part of the old fleet was retired. He established a flight training program approved under Part 141 of the Federal Aviation Regulations, which permitted advanced training beyond the Private Pilot level under the G.I. Bill. He encountered problems in dealing with the military mechanics which he solved by hiring a full-time civilian. Frustrated by continual shuffling of the club's location by the Army, he arranged for the club to install a large mobile home on the airfield and converted the interior into office space and classrooms. An aggressive drive increased the active membership to a peak of 147 in May of 1973. By the Fall of 1973, however, he had become disenchanted with the vagaries of dealing with the Army bureaucracy, and in November of that year he resigned to take advantage of a more attractive opportunity.

A new manager was hired in December 1973. Flight activity increased significantly, but little attention was devoted to administration, and this important aspect of club operation began to fall into disarray. Personality conflicts led to the dismissal of the full-time mechanic. Part-time Army men were employed once again, and a significant portion of the major engine repairs were sent to Monarch Aviation. Personal problems caused the second manager to resign in June of 1974.

Following the departure of the second manager, the day-to-day operations of the club were directed by a series of part-time member/managers. By October 1974, financial liquidity problems, which had begun under the second manager, became severe. The general condition of the club aircraft was poor and worsening, and the membership began to complain about poor aircraft availability. Alarmed by the deteriorating situation, the Board of Governors initiated a reorganization effort in early December. They elected a new president who possessed considerable general aviation management experience.

The reorganization effort was spurred by events. On 14 December, the club was closed due to unsatisfactory conditions revealed in the course of a routine administrative inspection. At the same time, the club was notified that the hangar spaces occupied by the club for parts storage and aircraft maintenance would have to be vacated immediately. The move was required by the relocation of various units in preparation for the influx of an additional Division at Fort Ord. The club was advised that space would be provided in another hangar located

at a considerable distance from the club trailer for indoor disassembly and repair of one aircraft at a time. Inventories of parts, tools, and materials were to be placed in two 12' x 8' x 6' bulk shipping containers adjacent to the newly assigned hangar.

Incredibly, the unsatisfactory conditions noted by the administrative inspectors had little to do with the major problems facing the club. Much attention was given to the lack of custody receipts for office furniture, and to the fact that the club Constitution and By-Laws were not in agreement with the latest changes to Army Regulations. The pressing demands of creditors, the marginal condition of club aircraft, and recent severe financial losses were only indirectly addressed. Nevertheless, it was clear that the continued viability of the club was in jeopardy.

A brief digression from the narrative is appropriate at this point. The above comments concerning the results of the administrative inspection highlight one of the major difficulties which routinely hinders the effective functioning of the club. There is a severe lack of understanding in the middle management echelons, both civilian and military, of the nature of flying club operations. To a large extent, this lack of understanding is due to unfamiliarity with civil aviation, but it nevertheless severely hampers the optimum functioning of the club.

As an example of the result of this lack of understanding, extensive and time-consuming administrative procedures are

required in order for the club to incur financial obligations greater than $500. Yet expenditures in excess of this amount are routinely required to maintain the aircraft. And the competitive bid procedures required for aircraft purchases are so time consuming as to effectively prevent the club from taking advantage of unique and attractive opportunities which normally exist for very brief periods, and which, if realized, would enable the club to provide its services at much reduced cost to its members.

Several steps were taken immediately upon closure of the club. The administrative discrepancies were corrected, which allowed the resumption of operations. Aircraft rental rates were compared with estimated operating costs and adjusted to profitable levels (see Appendix A for current cost estimates). Finally, an aggressive program to collect long overdue receivables and the sale of an aircraft engine provided funds to satisfy creditor demands.

A number of problems remained unresolved, however. First and foremost, several club aircraft were in need of replacement, but it was not clear how many newer aircraft should be procured. Second, serious doubt existed about the efficacy of current maintenance practices. Finally, planned increases in military operations at Fritzsche Army Airfield raised questions about the continued suitability of that location for club activities.

B. THE AIRCRAFT REPLACEMENT PROBLEM

1. Formulation

Table I presents the aircraft currently possessed by the club and a summary of their condition. The issue at hand is whether certain of the aircraft should be replaced by newer models, or, alternatively, repaired to a more satisfactory condition. But before this problem can be attacked, the systems analysis approach requires that the decision criteria be specified.

Clearly, the decision criteria will depend on.the objectives of the organization. In the case of the Fort Ord Flying Club in December 1974, the objectives may be defined as:

1. To provide flight training and recreational flying opportunities for eligible members at minimum cost.
2. To recover from the existing financial crisis as rapidly as is feasible in order to ensure continued ability to achieve the primary objective.

The first objective requires clarification. It implies that some fixed level of effectiveness is desired at minimum cost, as opposed to maximizing effectiveness subject to a specific level of expenditure. This distinction of the conceptual framework within which a problem will be approached is fundamental to the systems analysis methodology, and depends on the context of the problem [Ref. 3). In this case, the fixed level of effectiveness to be achieved is determined by the demand for flight time by current and prospective members of the club. But there is a qualitative issue involved in satisfying the demand at minimum cost. Costs may be minimized

TABLE I

Fort Ord Flying Club
Aircraft Inventory, December 31, 1974

Side Number	Make & Model	Description	Condition
N7113S	Cessna 150	Two-place, single-engine, fixed-gear, primary trainer	Serviceable. Needs upgrade of avionics & instruments.
N4380U	Cessna 150	Two-place, single-engine, fixed-gear, primary trainer	Serviceable. Needs upgrade of avionics & instruments. Interior shows wear.
N3661J	Cessna 150	Two-place, single-engine, fixed-gear, primary trainer	Serviceable. Extensive airframe corrosion. Needs major repairs to landing gear attachment. Interior badly worn.
N7247S*	Cessna 150	Two-place, single-engine, fixed-gear, primary trainer	Not serviceable. Extensive airframe corrosion. Engine disassembled for repair. Interior badly worn.
N5974S*	Beechcraft Musketeer	Four-place, single-engine, fixed-gear, basic trainer	Not serviceable. Disassembled for airframe corrosion repair. Needs paint.
N17282	Cessna T-41	Four-place, single-engine, fixed-gear, basic trainer	Serviceable. Needs corrosion repair, paint, interior repair, avionics upgrade. U.S. Army owned.
N5483	Cessna O-1A	Two-place, single-engine fixed-gear, basic trainer	Serviceable. Needs paint, avionics upgrade. U.S. Army owned.

TABLE I (cont'd)

Side Number	Make & Model	Description	Condition
N5482	Cessna O-1A	Two-place, single-engine, fixed-gear, basic trainer	Not serviceable. Engine disassembled for repairs. Needs avionics upgrade. U.S. Army owned.
N3618R	Piper Cherokee 180	Four-place, single-engine, fixed-gear, instrument trainer	Serviceable. Leased aircraft.
N6232P	Piper Commanche 250	Four-place, single-engine, retractable-gear, advanced & instrument trainer	Serviceable. Leased aircraft.
N6577D*	Cessna 195	Four-place, single-engine, fixed gear, advanced trainer	Not serviceable. Beyond economical repair.
N1063P*	Piper Apache	Four-place, twin-engine, retractable gear, advanced & instrument trainer	Not serviceable. Disassembled for corrosion repair. Leased aircraft.

*Aircraft marked with asterisk are scheduled for sale or return to Army/lessor.

in an absolute sense through the use of old, marginally equipped aircraft. Alternatively, newer, better equipped aircraft may be provided, with commensurate increases in cost to the membership. Thus, the level of effectiveness used to determine decision criteria must be defined in terms of both the quality and quantity of flight services demanded.

Obviously, the second objective listed above suggests a further restriction on the minimization of costs. In the long run, costs to the membership will be minimized if the club is operated on a break-even basis. Recovery of past financial losses, however, requires operation above break-even for some period, and the rate of recovery will be a function of both future profitability and future activity levels.

It should be clear from the above discussion that the problem at hand goes beyond a simple "replace or repair" decision. Succinctly stated, the problem is:

> What is the optimum mix and quality of aircraft which should be operated by the Fort Ord Flying Club in order to satisfy the flying demands of its members at minimum cost while recovering from previous financial losses?

2. Search

The second phase of the systems analysis approach to problem solving involves searching for relevant data and developing hypotheses about the problem. For the Flying Club example, an investigation into past flight activity should prove a fertile place to begin.

a. Flight Activity Analysis

Documents used in the preparation of members' monthly statements provided the flight activity data which

is presented in Appendix B. This data is summarized in Table II.

The Table II figures show that for the 22-month period from February 1973 to November 1974, approximately 76% of the club's flying was done in the Cessna 150 trainers. The club-owned 150's averaged 67.8 revenue hours per month for the months they flew. The more complex aircraft, however, averaged only 19.4 revenue hours per revenue month.

The column headed "Revenue hours as a percent of potential flying hours" is an attempt to obtain a measure of aircraft utilization. At 23% for all Cessna 150's and 6% for all complex aircraft, the utilization appears to be very poor. But, as is explained in footnote 2, the potential flying hours used to arrive at those percentages are based on eight hours per day (0900 - 1700) and thirty days per month. No allowance was made for weather interference with flight activity.

Weather is an important factor, obviously. Only a very small percentage of club members are qualified to fly in instrument conditions (less than 1,000 foot ceiling and/or less than three miles' visibility). Furthermore, if weather conditions are less than 3,000 foot ceiling and/or three miles' visibility, primary flight training is somewhat restricted, and few pilots would have much interest in recreational flying.

Historical weather data (see Appendix C) for Fritzsche Army Airfield indicates that on an annual basis,

TABLE II

Flight Activity Summary
February 1973 - November 1974 [1]

Aircraft	Total Revenue Hours Flown	Total Months Revenue Earned	Average Revenue Hrs Per Revenue Month [1]	Total Potential Flying Months	Total Potential Flying Hours [2]	Revenue Hrs as Percent Potential Flying Hrs	Total Non-Revenue Hrs Flown or Operated	Non-Revenue Hrs as % of Total Hours Flown	Total Hours Flown
N7113S (C-150)	1417.1	18	81.7	22	5280	28	16.8	1.2	1433.9
N3661J (C-150)	1452.2	19	76.4	22	5280	28	24.4	1.7	1476.6
N4380U (C-150)	832.3	18	46.2	22	5280	16	25.8	3.0	858.1
N7247S (C-150)	1387.0	20	69.4	22	5280	26	21.0	1.5	1408.0
N3970 (C-150) Leased	597.0	15	39.8	15	3600	17	12.2	2.0	609.2
All Cessna 150's	5685.6	90	63.2	103	24720	23	100.2	1.7	5785.8
C-150's excluding N3970 [3]	5088.6	75	67.8	88	21120	24	88.0	1.7	5176.6
N17282 (T-41)	595.3	22	27.1	22	5280	11	32.6	5.2	627.9
N1063P (Piper Twin) Leased	256.0	15	17.1	22	5280	5	66.0	20.5	322.0
N5974S (Beech Musketeer)	173.6	11	15.8	22	5280	3	21.9	11.2	195.5
N5169P (Piper Commanche) Leased	339.1	18	18.8	22	5280	6	32.8	8.8	371.9

TABLE II (cont'd)

Aircraft	Total Revenue Hours Flown	Total Months Revenue Earned	Average Revenue Hrs Per Revenue Month [1]	Total Potential Flying Months	Total Potential Flying Hours [2]	Revenue Hrs as Percent Potential Flying Hrs	Total Non-Revenue Hrs Flown or Operated	Non-Revenue Hrs as % of Total Hrs Flown	Total Hours Flown
N5483 (O-1A)	304.4	21	14.5	22	5280	6	5.2	1.7	309.6
N6577D (Cessna 195)	41.4	5	8.3	22	5280	1	.4	1.0	41.8
N3618R (Piper Cherokee) Leased	75.9	2	38.0	2	480	16	1.5	1.9	77.4
N6232P (Piper Commanche) Leased	41.1	1	41.1	1	240	17	--	--	41.1
All Complex Aircraft	1826.8	95	19.4	135	32400	6	160.4	8.1	1987.2
Total All Aircraft	7512.4	185	40.6	238	57120	13	260.6	3.4	7773.0

[1] December 1974 omitted from data due to club being closed 14-26 Dec. Jan 1973 data not available.

[2] Total potential flying hours = 30 days/mo x 8 hrs/day x total potential flying months.

[3] Cessna N3970 was a leased aircraft. Its use was discouraged due to low profit margin.

Fritzsche has weather better than 1,000'/2 miles 63% of the time, and better than 3,000'/3 miles 33% of the time between 0900 and 1700 [Ref. 5].

Table III shows potential flying hours and aircraft utilization adjusted for weather interference. Not surprisingly, aircraft utilization percentages improve dramatically as weather criteria increase, and the wide differential between Cessna 150 and complex aircraft utilization continues to hold. This differential arises primarily from two causes.

First, the complex aircraft, by virtue of their heavier weight, greater horsepower and more complicated powerplants, and in some cases, retractable landing gear, are more difficult to fly than the Cessna 150 trainers. They are also more costly to operate and maintain. Therefore, the training conducted in the complex aircraft is limited to the transition check-outs and instrument work associated with advanced ratings, and funded by veteran's benefits. This type of advanced training typically requires flights of long duration (often to distant airports), and therefore tends to be concentrated on weekends. Almost no privately funded recreational or personal transport flying is done in these aircraft during the week (Monday - Friday). Thus, these aircraft tend to sit relatively idle during the normal work week, only to be intensively utilized on the weekends.

Second, due to their complexity, the complex aircraft are more difficult to maintain. When mechanical problems occur, they usually take more time and expense to

TABLE III

Aircraft Utilization Data Adjusted for Weather

Aircraft	Potential Flt Hrs 1000'/2 or Better [1]	Revenue Hrs % of 1000'/2 Potential Hrs	Potential Flt Hrs 3000'/3 or Better [2]	Revenue Hrs % of 3000'/3 or Better
All Cessna 150's	15573.6	37	8157.6	70
N17282	3326.4	18	1742.5	34
N1063P	3326.4	8	1742.5	15
N5974S	3326.4	5	1742.5	10
N5169P	3326.4	10	1742.5	19
N5483	3326.4	9	1742.5	17
N6577D	3326.4	1	1742.5	2
N3618R	360.0	21	158.4	48
N6232P	180.0	23	79.2	52
All Complex	20498.4	9	10692.0	17

[1] Potential flight hours from Table II x .63 except for N3618R & N6232P which use factor of .75 due to better than average weather during November and December - the only months they flew.

[2] Potential flight hours from Table II x .33.

repair than the training aircraft. This fact, coupled with intermittent demand by a minority of the membership, leads to "last priority" maintenance in an organization where funds and maintenance personnel are scarce. In Table II, the difference between "revenue months" and "potential flying months" reflects periods when the aircraft didn't fly, presumably because they were not flyable. The problem of aircraft maintenance and availability will be addressed in detail later. It will suffice at this point to note that utilization of all club aircraft is affected by availability problems, and the complex aircraft suffer more from this malady than do the Cessna 150 trainers.

With the preceding discussion in mind, examination of Table II and Table III reveals that the club aircraft are under-utilized. Using 1,000'/2 miles as an approximation of the minimum weather conditions acceptable for visual operations (and also because the data happens to be available), the Cessna 150's have flown 37% of the potential flight hours during the past two years, and the complex aircraft are worse at only 9% on the average. Two of the complex aircraft, N3618R and N6232P, show significantly higher utilization than the others in that category, at 21% and 23%, respectively, of the potential flight hours in 1,000'/2 miles or better weather. These figures are of interest because the two aircraft are the most costly in the fleet, renting for $22 and $25 per hour. The higher utilization of N6232P is due in part to recent changes in Federal Aviation Regulations which require more training

for advanced flight students in complex, high-performance, retractable-gear aircraft. Both aircraft are newer, better equipped, and nicer looking than the other planes in the fleet. But there is little difference in performance between N3618R and one of the Army surplus aircraft, N17282 for example, which is old, somewhat noisy, not very pretty to look at, and rents for $15.50 per hour. The higher utilization of N6232P and N3618R, novelty considerations aside (these planes have been available for less than two months), seem to indicate a willingness on the part of the members to pay higher rates for better quality equipment. In other words, utilization may not be terribly sensitive to price, so long as rental rates remain noticeably lower than commercial charges.

Non-revenue operations occur as a result of maintenance ground checks and test flights, and administrative flights for parts pick-up, recovery of stranded aircraft, etc. This data was included in Table II primarily to discover whether non-revenue activities constituted a constraint on aircraft availability for revenue operations. It is clear that they do not. From a management standpoint, however, the tendency to use the more expensive aircraft for administrative purposes should be recognized as a costly luxury. Administrative flight costs obviously should be minimized by conducting such flights in conjunction with revenue producing training flights, or by employing the least expensive aircraft which will meet the need. Certainly, the

devotion of 20% of the total flight time of the Apache Twin, N1063P, to administrative flights was excessive, and steps should be taken to preclude such extravagance in the future.

In addition to aircraft rental, an important service demanded by the membership is flight instruction. The availability of flight instructors is critical to the successful operation of the club, since the vast majority of its members join for the specific purposes of learning to fly or improving flying skills. Instructional flights are scheduled on the basis of mutual convenience for both student and instructor, subject, of course, to aircraft availability.

Table IV presents data relating aircraft flight time to Certified Flight Instructor activity for the last six months of 1974. During this period, the club employed one full-time instructor who also performed certain management functions. The full-time instructor was supplemented by as many as six members who possessed CFI ratings and who instructed on a part-time basis. Table IV shows that approximately 80% of the Cessna 150 flight time during the period required the services of a flight instructor. Slightly more than 62% of the complex aircraft time required an instructor, and this figure jumps to almost 85% for the complex aircraft used for advanced training and instrument work. It is clear that instructor availability could constitute a major constraint for club operations.

TABLE IV

Flight Instructor Activity as a Percentage of Flight Hours, by Aircraft
July 1974 - December 1974

Aircraft Month, 1974	C-150 N7113S		C-150 N3661J		C-150 N4380U		C-150 N7247S		O-1A N5483		T-41 N17282		PA-28-180 N3618R		PA-24-180 N5169P		PA-24-250 N6232P	
	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI	FLT	CFI
Jul	80.6	72.5	83.2	76.7			78.3	75.5	16.2		.6				13.9	18.5*		
Aug	66.0	45.4	84.5	78.6	3.1		74.4	70.7	8.3	7.1	27.2	7.3			17.0	14.7		
Sep	76.2	48.4	52.5	38.4	40.4	13.0	57.9	44.6	1.5		12.0	8.5			30.8	20.3		
Oct	78.7	78.3	71.6	58.1	70.4	41.9			11.4		14.2	1.3	7.4	5.7	36.4	24.4*		
Nov	102.1	68.2	51.0	38.1	49.6	31.1			25.6	6.3	51.5	18.7	68.5	57.3	22.7	20.2	41.1	44.3*
Dec	29.5	23.7	19.6	20.2*	24.7	24.8*			13.8	2.5	12.7	1.1	23.1	22.5			45.3	31.5
Total	433.1	336.5	362.4	310.1	188.2	112.8	210.6	190.8	76.8	15.9	118.2	36.9	99.0	85.5	120.8	98.1	86.4	75.8
CFI ÷ FLT	.777		.856		.599		.906		.207		.312		.864		.821		.877	

All C-150 CFI ÷ FLT = 950.2 ÷ 1194.3 = .796

All Complex CFI ÷ FLT = 312.2 ÷ 501.2 = .623

Retractable Gear Complex CFI ÷ FLT = 259.4 ÷ 306.2 = .847

*CFI time may exceed flight time due to pre- and post-flight briefings with student.

Note: Aircraft omitted from this table either have been, or are scheduled to be, sold/returned to lessor. Piper Commanche 5169P is no longer in service.

Another significant constraint on club flight activity is the availability of aircraft fuel. The club is authorized 600 gallons of 115/145 octane aviation gasoline from the Army at the military contract price. This fuel is used in the complex aircraft. The Cessna 150's require 80/87 octane fuel which is obtained from commercial suppliers. During the so-called "energy crunch" of 1974, the club exceeded its allotment of 80/87 fuel several months consecutively. It has applied to the appropriate authorities for an increase in its allotment of 80/87 to an average of approximately 1820 gallons per month, although no restrictions are currently enforced by the commercial supplier. Furthermore, the Army has been requested to increase the military contract allotment to 2000 gallons per month.

A final aspect of club flight activity which is of some interest is presented in Table V which shows that for a recent 22-month period the flight activity of the club membership has fluctuated fairly closely around an average value of 2.6 hours per month per member.

b. Financial Analysis

Since the problem at hand is concerned with the financial condition of the club, an examination of its financial history should prove of interest. Quarterly Profit and Loss, Balance Sheets, and Sources and Uses of Funds statements for 1973 and 1974 are provided in Appendix D.

Examination of the financial data reveals that approximately three-fourths of the club's revenues are provided by aircraft rentals. About twenty percent of its

TABLE V

Flight Activity Per Member
February 1973 - November 1974

Month	Total Revenue Hours [1]	Dues-Paying Members During Month	Revenue Hours Per Member Per Month
1973			
Feb	419.1	144	2.9
Mar	311.8	140	2.2
Apr	369.6	145	2.5
May	251.1	147	1.7
Jun	431.5	140	3.1
Jul	310.5	141	2.2
Aug	314.1	134	2.3
Sep	295.8	125	2.4
Oct	299.7	123	2.4
Nov	283.7	122	2.3
Dec	288.5	117	2.5
1974			
Jan	321.0	120	2.7
Feb	372.9	127	2.9
Mar	383.6	133	2.9
Apr	403.2	127	3.2
May	427.9	137	3.1
Jun	423.8	139	3.0
Jul	298.6	138	2.2
Aug	305.9	132	2.3
Sep	275.8	121	2.3
Oct	308.1	119	2.6
Nov	412.6	113	3.7

[1] Source: Appendix B

income is derived from membership dues and initiation fees, with the remainder provided by ground school instruction and miscellaneous activities.

Members are billed at the end of the month, with accounts due by the end of the following month. Members pursuing training programs which are subsidized by veterans' benefits (referred to as VA students) have traditionally been allowed considerable payment latitude in view of the extensive delays encountered in receiving reimbursement checks from the Veterans' Administration. The fact that VA students are required to fly a minimum of ten hours per month (many fly considerably more), coupled with the customary practice of carrying their accounts until reimbursement checks arrive, causes a major portion of club accounts receivable to be generated by a minority of the membership.

The expenses of the club arise from two broad categories of activity: aircraft operations and club administration. Aircraft operation and maintenance expenditures absorb more than three-fourths of the club's revenues, and at times have exceeded income (Appendix D). General and administrative expenses consume about one-fifth of total income, or roughly the portion of income generated by dues and initiation fees.

The major component of general and administrative expense, management compensation, camouflages an important aspect of club operations. Historically, the Contract Manager has been required to perform (or employ clerical help

at his own expense) the burdensome functions associated with VA record-keeping and pilot certification, as well as the routine administrative duties involved in a normal Non-appropriated Fund. These additional functions are required by federal and state regulations governing aviation and veterans' training. Compliance with these regulations results in significant costs which are unique in comparison with other Non-appropriated Funds.

Table VI presents a summary of the important profit and loss figures in common-size format, and relates the expenses of flight operations to flight activity data from Appendix B. Table VI also shows several standard financial liquidity ratios on a quarterly basis and a schedule of historical aircraft rental charges.

The data in Table VI suggests that the financial problems of the club stem from two causes: failure to adjust aircraft rental rates to compensate for rapidly increasing operating expenses, and failure to maintain adequate financial liquidity.

It is clear from Table VI that aircraft operating expenses have risen rapidly during 1973-1974, while general and administrative expenses have fluctuated around a fairly constant level. Maintenance expense, a major component of operational expense, showed a slight declining trend during 1973, but rapid rises in 1974 may reflect both the increasing age of the aircraft and the delayed impact of previous scrimping on maintenance. The sudden decline in both

TABLE VI

Financial Data Summary, 1973-1974

	1973				1974			
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
Operational Expense as % of Income	67	74	77	74	82	94	107	75
G & A Expense as % of Income	20	29	37	31	17	20	13	20
Net Profit (Loss) as % of Income	13	(3)	(15)	(4)	2	(14)	(21)	4
Maintenance Expense as % of Income	36	32	34	26	40	41	65	28
Operational Expense $/Flt Hr[1]	9.49[2]	10.12	11.04	10.13	12.50	13.09	17.13	13.87
Current Ratio	3.39	2.65	1.50	1.70	1.39	1.06	.93	1.26
Cash on Hand/Current Liabilities	1.88	1.39	.48	.34	.31	.18	.15	.32
Accounts Payable/Average Day's Sales[3]	--	--	--	--	9.4	36.2	60.6	45.2
Accounts Receivable/Average Day's Sales[3]	45.9	41.1	36.3	42.9	53.3	62.4	70.5	54.4
Cessna 150 Hourly Rental Rate	$8.00	$8.00	$8.00	$8.00	$8.00	$9.00	$13.50	$13.50

[1] 1973 and 1974 figures do not include ground school instructor cost.

[2] Computed on basis of estimated flight activity - January 1973.

[3] Average day's sales computed: Total income ($) for quarter ÷ 90 days.

operational and maintenance expense relative to income in the last quarter of 1974 is probably misleading. Flight activity and aircraft maintenance ceased entirely for over half of December. It seems likely that had normal operations been continued throughout the last quarter, expenses would have reflected established trends.

Unfortunately, the accounting practices of the club make an analysis of operational and maintenance expenditures by aircraft type infeasible. But a comparison of the Table VI data on total operational expense per flight hour with rental rate adjustments of the Cessna 150's (which contribute nearly 80% of the flight hours) seems to indicate that rental rate adjustments have lagged behind cost increases.

A firm's current ratio (current assets ÷ current liabilities) is a commonly used measure of its ability to meet current financial obligations. The ratio of cash on hand to current liabilities also reflects ability to meet the immediate demands of creditors. The ratios of accounts payable and accounts receivable to average day's sales indicate the payment and collection practices of the firm. The Table VI figures show disastrous declines in liquidity for the club during 1973 and the first three quarters of 1974. At the end of September 1974, the club could have paid a paltry 15% of its debts out of cash on hand, and only 93% of the outstanding obligations could have been satisfied if all accounts receivable had been collected. The analysis of payables and receivables in Table VI shows that the club

operated on a cash basis with its creditors in 1973. But in 1974, it became increasingly dependent on trade credit to finance its operations. The receivables collection practices of the club deteriorated in a similar fashion. By the end of the third quarter of 1974, it was over two months behind, based on average day's sales, in collecting receivables. Clearly, the burden of carrying members' accounts until checks arrived from the Veterans' Administration had become intolerable.

Based on the above analysis, the moves by the Board of Governors in December 1974 to adjust aircraft rental rates, to collect outstanding receivables, and to pay off creditors were certainly appropriate, if not exactly timely. Their efforts are reflected in the sharp fourth quarter turnaround of the liquidity and receivables/payables ratios. But more will have to be done along these lines before any lending institutions can be approached to secure funds for replacement aircraft.

One final aspect of club financial operations deserves comment. No formal budgets are prepared by the management. Flight activity forecasting and financial planning have traditionally been of the "hip pocket" variety. There is, however, a loose policy to the effect that the general and administrative expenses of the club should be covered by monthly membership dues (as they historically have been, for the most part), and that aircraft rental charges should cover aircraft operating and maintenance expenses.

Based on the data available, the following hypotheses appear reasonable:

1. Club flight activity for any period can be predicted on the basis of membership during the period.

2. Aircraft operating profits are determined by variable profits from aircraft operations less aircraft ownership and maintenance fixed costs.

3. Total variable profit from aircraft operations is determined by flight activity, which in turn depends on weather, fuel and instructor availability, aircraft availability, and demand for flying by the membership.

4. Club revenues in any given period result from aircraft rental, ground school fees, and membership dues. Total revenues minus aircraft operating expenses and administrative expenses gives net profit for the period.

3. Evaluation

In the evaluation phase, the systems analyst is concerned with developing models which relate the variables relevant to his problem.

The first hypothesis of the preceding section postulates that club membership can be used to predict flight activity. The data in Table V suggest that some relationship exists between dues-paying members and flight activity, since monthly per-member flying fluctuates around an average of 2.6 hours. However, not all dues-paying members fly. And furthermore, among the dues-paying members who fly actively, persons enrolled in VA training programs can be expected to fly more hours in any given period than the average flying member, since VA students are required to fly a minimum of ten hours per month.

Linear regression using the method of least squares is a commonly used technique for analyzing the relationship

between variables, and then making predictions based on the result. References [6] and [7] contain detailed explanations of regression analysis.

To test the utilization of membership as a predictor of flight activity, a stepwise linear regression analysis was performed. The independent variables used (and their sources) were:

1. Total dues-paying members (Table IV)
2. Total VA members (Appendix E)
3. Actively flying members (Appendix E)
4. Proportion of VA to total members (transgeneration)
5. Proportion of VA to actively flying members (transgeneration)

The dependent variable was the monthly flight hour data listed in Table V. Tables VII and VIII show the results of the regression analysis.

The matrix of correlation coefficients in Table VII reveals that there is no strong relationship between any of the independent variables and flight activity. The data in Table VIII shows that none of the combinations of variables listed will provide very meaningful predictions of flight activity.

The second hypothesis postulated that aircraft operating profits are determined by variable profits from aircraft rental less the fixed costs of owning and maintaining the aircraft. For any aircraft inventory and any period, this relationship can be represented:

eq (1) $P_A = Z - F$

where P_A = total profits from aircraft rental

TABLE VII

Correlation Matrix for Flight Activity Variables

		1 FLTHRS	2 VAMBRS	3 TOTMBR	4 ACTMBR	5 PRVATO	6 PRVAAC
1	FLTHRS	1.000	.388	.206	.352	.291	.249
2	VAMBRS		1.000	-.280	.713	.967	.876
3	TOTMBR			1.000	.119	-.507	-.477
4	ACTMBR				1.000	.596	.298
5	PRVATO					1.000	.918
6	PRVAAC						1.000

TABLE VIII

Regression Results for Flight Activity Variables

Variables in Equation	Multiple R	Standard Error of Estimate
2	.3883	54.7058
2, 5	.5127	52.2921
2, 4, 5	.5193	53.4753
2, 4, 5, 6	.5828	52.3239
2, 3, 4, 5, 6	.5923	53.4747

Z = contribution (variable profit) from aircraft rental operations during the period

F = total fixed costs associated with aircraft ownership during the period.

Given the goal of improving the financial condition of the club, it seems reasonable to approach the aircraft rental operation from a revenue maximization viewpoint.

The third hypothesis suggests that the elements of club activity and operating environment which determine total variable profit from aircraft operations can be structured as a system of linear relationships. If the hours flown by individual aircraft are specified as the decision variables, it is possible to arrange these relationships into a linear programming problem [see Reference 8 for an explanation of linear programming] which has as its objective the maximization of variable profit from aircraft rentals.

It should be emphasized that the hours flown by any particular aircraft in any period are not wholly controllable by the club management. The design of flight training curricula can affect aircraft utilization to some degree, but actual utilization is determined primarily by the demand of the membership for recreational as well as training flights. Therefore, the linear programming model which follows should be understood as a means of interpreting the relationships of the factors which bear on club flight activity, and not as a standard for the evaluation of management performance.

The third hypothesis suggests that total variable profit from aircraft operations can be represented by the following relationships:

eq (2) $$Z = \sum_{i=1}^{n} c_i x_i$$

where Z = contribution from aircraft rental operations during the period

n = the number of aircraft in use during the period

i = each specific aircraft used during the period, $i = 1, 2, 3, \ldots n$

c_i = variable profit of aircraft i per flight hour

x_i = revenue hours flown by aircraft i during the period.

eq (3) $$x_i \leq w\,f\,T$$

where x_i = revenue hours flown by aircraft i during the period

w = a weather factor determined by the percentage of available flying hours during which suitable flying conditions prevail

f = a turnaround factor which estimates time lost in aircraft refueling, etc.

T = total hours available for flying without considering weather and turnaround factors.

eq (4) $$\sum_{i=1}^{n} j_i x_i \leq Q_{F_i}$$

where n = number of aircraft in use during the period

i = each specific aircraft in use during the period

j_i = fuel consumption of aircraft i in gallons per hour

x_i = revenue hours flown by aircraft i

Q_{F_i} = available quantity of fuel required by aircraft i.

eq (5) $\sum_{i=1}^{n} d\, x_i \leq I$

where n = number of aircraft in use during the period

d = the percentage of flight hours requiring a flight instructor

i = each aircraft used during the period

x_i = revenue hours flown by aircraft i during the period

I = total instructor hours available.

Using the preceding relationships, the techniques of linear programming can be employed to determine the maximum variable profit obtainable from any chosen mix of aircraft, subject to the constraints imposed by weather, fuel limitations, and instructor availability. Aircraft flight hours will be used as the decision variables, even though it is recognized that they are not entirely controllable by management.

If it is assumed that:

1. The club has the use of three Cessna 150's, two O-1A's, one Cherokee 180, one T-41, and one Commanche 250,
2. The variable profit figures in Appendix A are valid,
3. Aircraft are available for flights between 0900-1700, and therefore T = 240 hours per month,
4. The minimum weather conditions for flight are 1,000'/2 miles, and therefore w = .63 for Fritzsche Airfield (Appendix C),
5. Twenty percent of available flight time is absorbed by fueling and preflight operations, and therefore f = .80,

6. Total flight instructor hours available are as follows:
   1 Chief pilot/manager @ 3 hrs/day, 7 days/week = 84 hrs/month
   5 Part-time instructors @ 5 hrs each, Monday-Friday and 3 hrs each Saturday & Sunday = 220 hrs/month
   Therefore I = 304,

7. 80% of all flights require an instructor,

8. Total 80/87 fuel available = 1820 gallons/month,

9. Total 115/145 fuel available = 600 gallons/month,

then the objective function of the linear programming problem becomes:

Maximize

(a) $Z = 6.65\,x_1 + 6.65\,x_2 + 6.65\,x_3 + 4.50\,x_4 + 4.50\,x_5 + 4.94\,x_6 + 3.72\,x_7 + 1.47\,x_8$

Subject to

(b) $x_1 \leq 121$
(c) $x_2 \leq 121$
(d) $x_3 \leq 121$
(e) $x_4 \leq 121$
(f) $x_5 \leq 121$
(g) $x_6 \leq 121$
(h) $x_7 \leq 121$
(i) $x_8 \leq 121$
(j) $5x_1 + 5x_2 + 5x_3 \leq 1820$
(k) $10x_4 + 10x_5 + 10x_6 + 11x_7 + 14x_8 \leq 600$
(l) $.8x_1 + .8x_2 + .8x_3 + .8x_4 + .8x_5 + .8x_6 + .8x_7 + .8x_8 \leq 304$
(m) $x_n \leq 0 \quad n = 1, 2, 3, \ldots 8$

where x_1, x_2, x_3 = revenue hours flown by the Cessna 150's
x_4, x_5 = revenue hours flown by the O-1A's
x_6 = revenue hours flown by the Cherokee 180
x_7 = revenue hours flown by the T-41
x_8 = revenue hours flown by the Commanche 250

The maximum variable profit per month under the above conditions is \$2,497.93. This figure can only be achieved by flying the three Cessna 150's 121 hours each (the maximum allowable) and by flying the Cherokee 180 seventeen hours, for a total of 380 hours. None of the remaining aircraft are operated at all. At the end of the month, there are five gallons of 80/87 fuel and 430 gallons of 115/145 fuel remaining. All of the available instructor time is exhausted.

In this example, instructor availability is the factor which limits the total variable profit obtainable. The usual procedure under systems analysis would be to assess the sensitivity of variable profit to changes in instructor hours available. But it is clear from the constraint equations that if unlimited instructor hours were available, 115/145 fuel would become the limiting factor, since 588 potential flying hours remain for the complex aircraft, but only 430 gallons of 115/145 fuel are unused. Some time can be saved at little sacrifice if it is recalled that the club has requested an increase in its 115/145 fuel allotment from the Army to 2,000 gallons per month. If the maximum variable profit is calculated for the new quantity of 115/145 fuel, with no instructor limit, the instructor hours required can easily be computed.

For this second problem, the objective function remains the same. Constraint equation (k) becomes:

$$10x_4 + 10x_5 + 10x_6 + 11x_7 + 14x_8 \leq 2{,}000$$

and constraint (l) is removed.

Under these new conditions, the maximum variable profit is \$3,367.13. All the Cessna 150's and the Cherokee 180 are flown up to the maximum weather limit of 121 hours. Seventy-nine hours are flown by the O-1A's in total. Again, there are five gallons of 80/87 fuel remaining, but the 2,000 gallons of 115/145 are exhausted. Total instructor hours required during the month are 563 hours x .80, or 450.4.

Before applying the variable profit model to current club activity levels, several observations are necessary.

One conclusion that might be drawn from the analysis so far is that the club should dispose of one O-1A, the T-41, and the Commanche 250, since these aircraft are not flown at all under the conditions examined.

The reason that these aircraft are not flown is that the variable profit maximization model inherently gives first priority for the scarce resources of usable flight time and available fuel to the aircraft providing the greatest variable profit per flight hour. Given the present revenue/cost structure, total variable profit will always be maximized when scarce resources are allocated first to the Cessna 150's, then to the Cherokee 180, and so on, in order of diminishing variable profit rates per hour.

Recalling that equation (1) states that total profit from aircraft operations (P_A) is determined by total variable profits less the fixed costs of ownership and maintenance, it is obvious that P_A will be maximized when total variable profit is maximized and total fixed costs are held to

a minimum. Minimization of aircraft fixed costs clearly can be achieved by disposing of aircraft which are not employed in variable profit maximization.

For example, the first iteration of the model produced a maximum variable profit of \$2,497.93. The total fixed costs per month of the aircraft owned (but not necessarily used) from Appendix A is \$1,145.00. Therefore the average monthly profit from aircraft operations is

$$P_A = Z - F = \$2,497.93 - \$1,145.00 = \$1,352.93$$

But if the unused aircraft are disposed of, the profit from aircraft operations becomes

$$\$2,497.93 - \$1,082.50 = \$1,415.43$$

and the monthly increase in P_A is due to the saving of fixed costs of \$29.17 and \$33.33 from the unused O-1A and T-41, respectively. No fixed costs would be recouped from return of the leased Commanche 250 to the lessor.

The question now arises: Are the disposal actions suggested by the profit maximization model feasible? The answer lies in the original formulation of the problem, which was to determine the optimum mix of aircraft which would satisfy the needs of the membership while speeding financial recovery. In that light, the disposal of the Commanche 250 is not feasible, since flight in that class aircraft is required by several training curricula offered by the club and demanded by the membership. The same may be said with regard to the T-41 and the O-1A.

A final aspect of the variable profit maximization model deserves attention. This aspect has to do with the fact that the model ignores the relationship between membership demand, variable profit rates, and the differing monthly fixed costs of the various aircraft in use by the club.

The monthly flight hours required to cover the fixed costs of any aircraft type (break-even hours) are easily computed by dividing monthly fixed cost by the variable profit rate. From the data in Appendix A, it can be seen that under the current pricing scheme, Cessna 150 fixed costs are covered when the aircraft has flown 52.8 hours. Similarly, T-41 fixed costs are covered after nine hours of flying, and the O-1A requires only 6.5 hours. The Cherokee 180 and Comanche 250 have no fixed costs due to the nature of their lease contracts.

If any of the club-owned aircraft are flown less than the hours required for coverage of fixed costs, and the remaining aircraft fly more than break-even hours, some members are in effect subsidizing the equipment flown by others. This inequitable possibility is ignored by the variable profit maximization model.

In summary, then, the variable profit maximization model is useful only to the extent that it highlights the steps necessary to achieve maximum income from aircraft operations under the constraints indicated. It is clear that these steps are not feasible, given the nature of club activities. The relationships identified in that model will

prove useful, however, in developing more realistically formulated alternatives.

The discussion from this point forward requires identification of certain assumptions.

First, it will be assumed that monthly membership dues cover the general and administrative expenses of the club, and the costs of ground school instruction are met by the fees charged. Therefore, financial recovery is predicated on the profits generated by aircraft operations. Increases in monthly dues will not be considered as a possible contribution toward financial recovery because such a step would violate the policy that dues should only cover the general and administrative expenses of the club. Increases in ground school fees beyond a break-even figure will not be considered because even at current rates, it is difficult to achieve adequate student participation in this necessary but unexciting part of aviation.

Second, financial recovery will be presumed to be complete when the club acquires liquid cash reserves of $5,000. This amount is chosen because it would allow immediate replacement of a ruined engine in any club-owned or Army-provided aircraft, should that occur prior to normal replacement. Furthermore, this amount, coupled with insurance proceeds, would facilitate immediate replacement of a club-owned Cessna 150 in the event of total loss from an accident.

Third, soon-to-occur changes in the nature and duties of Fort Ord military personnel, and thus the majority of club

membership, will allow flight activity to be distributed evenly throughout the week.

Fourth, the dues-paying membership is the best available predictor of demand for flight activity, at approximately 2.5 hours per month per member. This assumption is clearly tenuous, based on previous analysis, but, again, it is the only source available to club management.

Fifth, the optimum aircraft inventory is that which satisfies the demand of the membership with the highest utilization per aircraft. This assumption follows from the common-sense notion that it makes little sense to absorb the fixed costs of aircraft which are not used.

Given the above assumptions, it is now possible to specify several alternative mixes of club aircraft and the operational consequences which result from each mix. An analysis of the implications of the various mixes will follow the identification of the alternatives.

Alternative 1

The club presently possesses three operable Cessna 150's, one operable O-1A, one T-41, one Cherokee 180, and one Commanche 250. If average weather and turnaround requirements limit monthly flight hours to 121 per aircraft, the maximum variable profit available from this mix is $4,184.18. This level of activity will require 1,815 gallons of 80/87 fuel and 6,655 gallons of 115/145 fuel. It will also require 667.6 man-hours of instructor time, or roughly 23 man-hours per day. Total monthly fixed cost for this mix

is $1,115.83, therefore aircraft rental profit is $3,068.35. Total membership that could be supported at 2.5 hours per month is 339.

Alternative 2

If the Alternative 1 aircraft inventory were reduced by one Cessna 150, the potential total variable profit becomes $3,379.53 per month. The 80/87 fuel requirement will decrease to 1210 gallons. Total flight hours will be 726 during the month and 581 instructor hours, or roughly twenty hours per day, will be needed. Total fixed costs decrease to $764.72, for a total profit from aircraft operations of $2,614.81. Note that under maximum operating conditions, $453.54 of profits are lost by the disposal of one Cessna 150 at a savings of $351.11 in fixed costs. The total membership that can be supported is 290.

Alternative 3

A membership roster of 100 persons implies a total demand of 250 flight hours per month. Historically, about 80% of club flight activity has been accomplished in Cessna 150's. Assuming that this .8 ratio holds, and that flight hours are distributed evenly within the Cessna 150 and complex categories, the Alternative 1 inventory will result in 67 flight hours per month per Cessna 150, and 12.5 hours per complex aircraft. Total variable profit will be $1,512.88. Subtracting fixed costs of $1,115.83, profit from aircraft operations becomes $397.05. Total 80/87 and 115/145 fuel consumed will be 1,000 gallons and 562 gallons, respectively.

Approximately seven hours per day of instructor time are needed. All aircraft having fixed costs are operated comfortably above break-even.

Alternative 4

If the aircraft inventory in Alternative 3 is reduced by one Cessna 150, but membership remains at 100 and 80% of total flight hours continue to occur in Cessna 150's, all fuel consumption and instructor requirement figures remain the same as in Alternative 3. Cessna 150 utilization increases to 100 hours per month, however, and fixed costs are reduced to $764.72. Profit from aircraft operations becomes $748.16.

Alternative 5

If club membership increases to 150 members, the average monthly demand for flight activity can be presumed to be 375 hours at 2.5 hours per member. If three Cessna 150's, one O-1A, one T-41, one Cherokee 180, and one Commanche 250 are operated, and 80% of total flying is accomplished in the Cessna 150's, Cessna 150 utilization will be 100 hours per month, and the complex aircraft will average 18.75 hours each. Total monthly variable profit will be $2,269.32. Subtracting fixed costs of $1,115.83 gives an average monthly profit from aircraft operations of $1,153.49. A total of 1,500 gallons of 80/87 and 843 gallons of 115/145 fuel will be consumed. Some 300 hours of instructor time, or ten hours per day, will be required. It is worthy of note that the current allotment of 600 gallons of 115/145 gas is exceeded in this scenario, but consumption is well within the 2,000 gallons expected to be available in the near future.

Alternative 6

With 150 members, as in Alternative 5, demanding an assumed 375 flight hours, it is not possible to reduce the Cessna 150 fleet as in previous cases, because if 80% of the flying is presumed to be done in 150's the two remaining aircraft would be required to fly 150 hours each, which exceeds the available time of 121 hours per month. If the percentage of total flight time in 150's could be reduced from 80% to 60%, however, monthly flight hours per 150 would decrease to a comfortable 112.5 hours each. There is no type of training done in 150's which cannot be accomplished in the more complex aircraft, and the O-1A even rents for the same rate per hour as the 150's. Slight modification of the training curricula could easily accomplish the shift in activity. If the shift could be achieved, the complex aircraft utilization would rise to 37.5 hours each, assuming the additional hours were equally distributed. Total variable profit would be $2,044.88. Subtracting total fixed aircraft costs of $764.72 gives an average monthly profit from aircraft operations of $1,280.16. Total 80/87 fuel consumption would be 1,125 gallons and 115/145 consumption would be 1,687 gallons, well within the expected allocation. Flight instructor requirements would remain the same as in Alternative 5, about ten flight hours per day.

It is now possible to examine the implications of the preceding alternatives.

Alternatives 1 and 2 are clearly theoretical maxima for the two aircraft mixes. Both cases suggest membership

totals in the vicinity of 300 members, a level which is not likely to be achieved in the near future. Both cases also involve the consumption of over 6,600 gallons of 115/145 fuel, or some 4,600 gallons beyond the amount expected to become available in the foreseeable future.

Alternatives 3 and 4 compare the effect of two mixes of aircraft at current membership and flight activity levels. The benefits gained by reducing the Cessna 150 inventory from three to two aircraft are considerable. Monthly profit from aircraft operations increases 88%, from $397.05 to $748.16, through avoidance of the fixed costs of one Cessna 150, and the utilization of the remaining 150's rises sharply from 67 to 100 hours per aircraft.

Alternatives 5 and 6 compare the effect of two aircraft mixes at a moderate increase in membership and flight activity above current levels. Again, improved profits and utilization result from operating two vice three Cessna 150's. Utilization of the complex aircraft also increases due to the necessary shift in flight activity from 150's to the complex planes. Both Alternatives 5 and 6 highlight the fact that growth from 100 to 150 members will require an increase in 115/145 fuel allotment. They also make it clear that operations at this level will require an additional full-time flight instructor, since approximately ten hours of dual instructional flights can be expected daily.

4. Interpretation

The financial data in Appendix D shows that as of December 31, 1974, the club had a total of $14,083.89 in cash and accounts receivable. Assuming all the accounts receivable are collected, settlement of current liabilities of $11,525.07 leaves a cash balance of $2,558.82. Therefore, approximately $2,450 must be generated from aircraft profits to achieve the $5,000 cash balance previously defined as the financial recovery condition.

Additionally, the current Cessna 150 fleet must be replaced in order to meet the demands of the club membership for newer, better quality equipment.

Analysis of the alternatives previously presented indicates that two Cessna 150's are sufficient to meet present and foreseeable demand for this type aircraft. Therefore, the most appropriate course of action seems to be to sell the one disassembled and three operable Cessna 150's currently owned by the club. The proceeds of this sale should be applied toward the purchase of two newer aircraft.

Investigation of the current used aircraft market indicates that the sale of the four 150's owned by the club should generate in the vicinity of $10,000 at the very least. New Cessna 150's retail for approximately $14,000 equipped for club operations. It is clear that the proceeds of the sale of the old 150's will more than supply the 10-20% downpayment required for aircraft financing. Assuming financing is arranged so that the monthly payments approximate the $194

depreciation charge estimated in Appendix A, financial recovery to a cash balance of $5,000 will require slightly more than three months of average operations at current membership levels.

C. THE AIRCRAFT MAINTENANCE PROBLEM

1. Formulation

Fort Ord Flying Club expenditures for aircraft maintenance have increased significantly in recent years. The increase is noticeable both in the growing dollar amounts expended for maintenance (see Appendix D) and in the increasing portion of total income absorbed by maintenance activity. Table V in the preceding section shows that outlays for aircraft maintenance reached 65% of total income and slightly over $17 per flight hour in the third quarter of 1974. The $17 maintenance cost per flight hour is noteworthy because current cost estimates (see Appendix A) indicate that the highest hourly variable cost, including fuel and oil, for any club-owned aircraft should be $11.78. As was previously mentioned, the decline in both amount and proportion of funds applied to aircraft maintenance in the fourth quarter of 1974 was due to the financial straits of the club and the enforced cessation of all operations (including maintenance) for half of the month of December. The decline was certainly not due to a reduced need for maintenance. As Table 1 shows, the club aircraft, although airworthy, are not in excellent condition.

There is little doubt that one cause of the high overall maintenance cost per flight hour is the age of the Cessna 150 fleet. Just a few years of abuse at the hands of

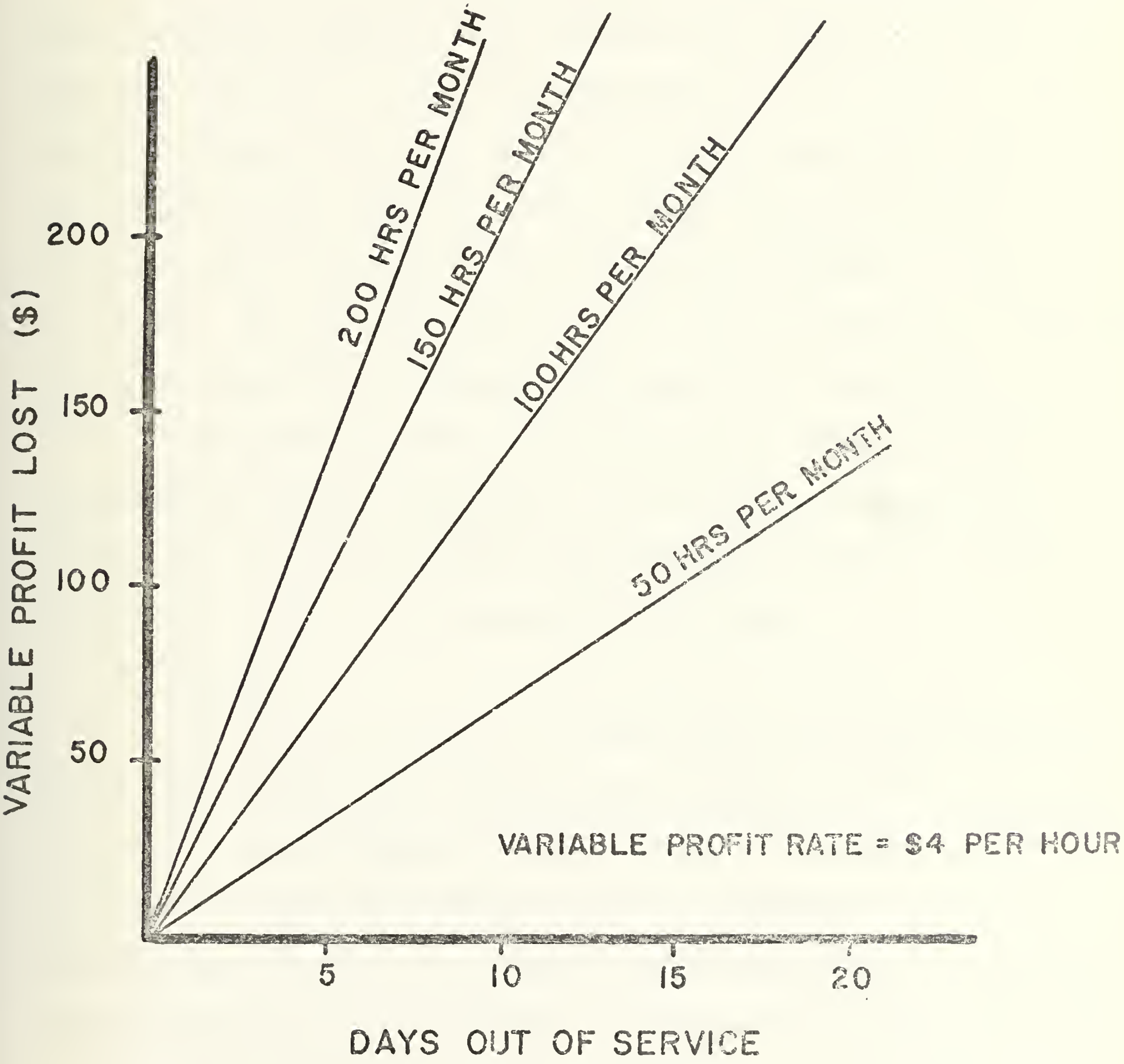
student pilots will rapidly tell on any training aircraft. Another cause is the corrosive atmosphere at Fritzsche Army Airfield, due to the close proximity of the ocean. A third factor is occasional ill-advised and expensive attempts to restore old, little-used aircraft to active service. But the most important cause is the multiplicative effect of delayed maintenance. Postponement of necessary work, whether driven by paucity of funds or by well-intentioned efforts to save money, eventually exacerbates the problem, causing greater expense in the end. This rule applies to routine preventative maintenance as well as the repair of abnormal breakdowns. And if repair of discrepancies which keep aircraft out of service is postponed, the additional costs of foregone revenue must be borne.

The importance of revenue lost when aircraft are out of service deserves emphasis. Graph 1 shows that the cost, in terms of contribution to fixed expenses, of an aircraft being out of service increases rapidly as utilization increases. This seemingly obvious relationship is often overlooked in conjunction with misguided efforts to save money on maintenance. Since the preceding section suggests adjustments to the current fleet which will result in utilization well in excess of 50 hours per month for certain club aircraft, the importance of this relationship is clear.

Replacement of the current fleet of Cessna 150's with newer aircraft should contribute to a reduction in overall maintenance cost per flight hour. Beyond religious attention

GRAPH I

VARIABLE PROFIT LOST BY AN UNSERVICEABLE AIRCRAFT



to aircraft wash and preventive maintenance schedules, little can be done to mitigate the effect of salt air on airframes. But there is one aspect of the club maintenance program which merits attention: the use of club mechanics for repairs versus sending aircraft to commercial repair firms.

A quick perusal of Appendix B reveals interruptions of up to several months in the revenue hours produced by many of the club aircraft. These interruptions in use are the result of the aircraft being in need of repair, rather than any lack of demand during the inactive periods. In some instances, the lengthy "down" time arose out of a lack of funds to repair the aircraft. But in most cases, it was due to delays in obtaining parts or insufficient maintenance labor for expeditious repair.

The problem, then, is to develop a decision rule for determining whether the costs of any necessary maintenance action will be minimized by employing club mechanics, or by sending the work to a commercial firm (FBO).

2. Search

Due to the high cost of most major airframe and power plant components, the club can only afford to keep items such as tires, brake linings, rivets, and other consumables in inventory. High-cost repair parts are purchased on an as-needed basis from local aircraft maintenance firms or ordered by mail from large wholesalers. Terms of list price less 10% are normally available from local firms. If the needed part is not stocked by the local firms, they can obtain it rapidly from their suppliers due to efficient purchasing procedures.

The club can achieve savings of 50% or more by ordering direct from surplus companies and major wholesalers, but such transactions often involve lengthy processing and shipment delays.

The club pays its mechanics, whether full- or part-time, at the rate of $4.13 per hour. The standard labor rate charged at local commercial firms is $15 per hour.

Based on the above information, the following decision rule is hypothesized:

Let

P_c = cost of parts at commercial FBO

H_c = estimated man-hours to repair at FBO

R_c = labor rate at FBO

T_c = time in days to repair at FBO

P_f = cost of parts (including shipping) if ordered by club

H_f = estimated man-hours to repair by club mechanics

R_f = labor rate for club mechanics

T_p = time in days to order and receive parts

T_f = time in days to repair at club, considering current projects and mechanic availability

π = variable profit foregone per day = (hours flown per month/30 days) x variable profit per hour

If: $P_c + H_c R_c + \pi T_c < P_f + H_f R_f + \pi(T_p + T_f)$

send the work to the commercial Fixed Base Operator. If the inequality sign is reversed, then, obviously, the repair should be performed by club mechanics.

3. Evaluation

Examination of a hypothetical problem offers the best means of evaluating the decision rule presented in the preceding section.

Assume a cracked exhaust manifold is discovered on a Cessna 150. A commercial FBO has a new manifold in stock which will cost $95 at 10% discount from list price. The FBO estimates that it will take four man-hours to remove and replace the manifold, and the hourly rate for labor is $15. The FBO can begin work as soon as the aircraft is brought to his facility.

Alternatively, the manifold could be purchased by the club from a discount supplier for $60, including shipping. It will take seven days to order and receive the part. The club mechanic can remove and replace the old manifold in four hours the evening of the day the part arrives. The labor rate for club mechanics is $4.13 per hour, and the Cessna 150 has been flying an average of 100 hours per month at a variable profit of $6.65 per hour.

At first glance, it might seem that the club should perform the work, since labor and parts charges would total $76.52, versus $155.00 at the commercial firm.

But if the assumed figures are substituted into the hypothesized decision rule, the following result is discovered:

$P_c = \$95$ $P_f = \$60$

$H_c = 4$ hours $H_f = 4$ hours

$R_c = \$15/\text{hr}$ $R_f = \$4.13/\text{hr}$

$T_c = 1$ day $T_p = 7$ days

$T_f = 0$, since the work is to be accomplished after normal flying hours the day the parts arrive.

$$\pi = \frac{100}{30} \times \$6.65 = \$22.17$$

$$\$95 + 4(\$15.00) + (\$22.17)1 < \$60 + 4(\$4.13) + (\$22.17)7$$

$$\$177.17 < \$231.71$$

Savings of $54.54 will be realized by sending the work to the FBO when the costs of the aircraft being out of service are considered.

4. Interpretation

The decision rule presented in this analysis is clearly useful in analyzing maintenance alternatives. It ensures that proper consideration is given to the costs of out-of-service aircraft.

A similar approach can be employed to determine priorities for aircraft maintenance. If two or more aircraft are out of service simultaneously, the aircraft having the highest variable profit foregone per day (π) should be repaired first, and remaining "down" aircraft should receive attention in decreasing order of daily variable profit foregone.

D. THE LOCATION PROBLEM

It was noted in the introductory material concerning the Fort Ord Flying Club that the continued suitability of Fritzche

Army Airfield as a location for club activities was open to question. This problem will now be addressed using the systems analysis approach.

1. Formulation

The location problem can be stated concisely without undue discussion. The problem is:

> What is the best location for the Fort Ord Flying Club, given the nature of the membership and the objectives of the club?

2. Search

The club began operations at Monterey Peninsula Airport. Club activities were conducted from a commercial Fixed Base Operator's facility located on the south side of the civilian airfield. This location was approximately twenty minutes' driving time from the central complex of Fort Ord, twenty-five minutes from the Defense Language Institute in Monterey, and about ten minutes from the Naval Postgraduate School, in the same city.

The club moved to Frtizsche Army Airfield in 1966 to take advantage of rent-free facilities and lower aviation fuel costs. Fritzsche Field is adjacent to the northern boundary of the Fort Ord Reservation, about ten minutes from the main complex. It is approximately thirty minutes' driving time from the Defense Language Institute, and about twenty minutes from the Naval Postgraduate School.

There are two other airports in the vicinity of the Monterey Peninsula which might be suitable for the flying club. The Salinas Airport is approximately fifty minutes' driving

time from the Monterey-Fort Ord area. Watsonville Airport is about an hour north of Monterey-Fort Ord.

A major consideration in any change in location is the weather characteristics of alternative airports. Watsonville Airport has no weather observation facility, so no data is available concerning its weather pattern. Like Fritzsche, Watsonville is located on low terrain near the seacoast and is subject to similar coastal stratus and fog conditions. Salinas Airport is well inland and is not troubled by coastal stratus to the same degree as the Watsonville, Fritzsche and Monterey Airports. Monterey Peninsula Airport is located at approximately the same distance from the coast of Monterey Bay as Fritzsche. It is on somewhat higher terrain, however, and it is sheltered by a range of hills immediately to the south, and therefore might be expected to enjoy better weather conditions than Fritzsche Field. Published weather data (Appendix c) indicates that on an annual basis Monterey Airport experiences average annual ceilings and visibility conditions better than 1,500'/3 miles 55.5% of the hours between 0900-1700. Adjusting this figure on a straight line basis to compare it with Fritzsche weather data at 1,000'/2 miles (Appendix C), it becomes 74%. This compares with 63% of the same hours at Fritzsche being better than 1,000'/2 miles.

While the above figures indicate that weather conditions are significantly better at Monterey than at Fritzsche, the straight line adjustment may not be valid. For the purposes of this analysis, however, it will be presumed that

the weather is on the order of 10% better at Monterey than at Fritzsche Army Airfield.

One of the consequences of a move from Fritzsche Field would be the loss of the 115/145 aviation gasoline presently obtained from the Army. Commercial 100/130 octane fuel is an acceptable alternate (and in some cases, a more desirable one) for club aircraft. But the wholesale price of 100/130 fuel is $.596 per gallon, or $.229 more expensive than the Army supplied gasoline.

Another consequence of the move would be the loss of rent-free facilities at Fritzsche. Discussion with management personnel at Monterey Peninsula Airport [Ref. 9] reveals that a monthly aircraft tiedown fee of $10 is levied for parking small, single-engine aircraft at that airport. Space to locate the club trailer adjacent to a parking ramp could be rented for $200 per month, and a small portable hangar of sufficient size to perform limited maintenance could be rented for approximately $50 per month.

The club estimates that it would cost on the order of $2,000 to move the trailer to Monterey and to tie in to necessary utilities at the new location.

No significant administrative costs would be avoided by departure from the Army field. The club would still be subject to the administrative regulations which pertain to on-post Non-appropriated Fund activities.

Several intangible benefits would accrue from a move away from Fritzsche Airfield. The numerous small annoyances

involved in the Army's procedures for filing flight plans and securing aircraft would be escaped. The hazards of operating small, fixed-wing aircraft amid intensive military rotary wing activity would be avoided. And a move would preclude the perennial, short-fuzed changes in location which occur due to assignment and transfer of military units on the airfield.

Two hypotheses concerning a move seem justified:

1. The Watsonville and Salinas airports are too distant from the three major sources of members (Fort Ord, the Naval Postgraduate School, and the Defense Language Institute) to be conveniently accessible.

2. Since no significant inconvenience appears to be involved in a move to Monterey Peninsula Airport, that location is the only feasible alternative site.

3. The decision to move to Monterey Peninsula Airport should depend on an analysis of the incremental funds flows that result.

3. Evaluation

The easiest aspect of the proposed move to Monterey to analyze is the effect of the additional fixed costs. Assuming the club will require tiedown space for seven aircraft, tiedown fees will total $70 per month. Adding ground rental for trailer parking of $200, and hangar rent of $50, to tiedown fees, gives a total incremental fixed cost of $320. Since club policy dictates that general and administrative expenses should be paid out of membership dues, at a total membership of 100 members the incremental monthly dues will be $3.20. With 150 members, the fixed cost increment is reduced to $2.13.

It is more difficult to assess the impact of the move on flight activity and the profits accrued from aircraft rental.

It may be presumed that the increases in variable cost per hour for aircraft requiring 100/130 fuel would be offset by commensurate increases in hourly rental rates. The T-41, for example, would have to be rented for $17.53 per hour (an addition of $.23 per gallon x 11 GPH = $2.53).

But disregarding for a moment the effect of rental rate increases on demand for the complex aircraft, there is no convenient way to evaluate the effect of improved weather on flight activity. Using the equations developed in the aircraft replacement analysis, and assuming the recommended two-Cessna 150 aircraft mix, the maximum feasible average monthly profit from aircraft operations can be shown to be $3,144.68, given the 10% better weather at Monterey. For comparison, the maximum feasible profit at Fritzsche with the same inventory was $2,614.81. But, as was previously emphasized, these figures are theoretical maxima, and are totally unrelated to membership demand.

The difficulty in assessing the impact on flight activity of a move arises because there is no way to evaluate the effect on monthly flight activity per member. There is no guarantee that a 10% increase in suitable weather will produce a 10% increase in flight hours per month per member. Clearly, if the average member continues to fly the same number of hours per month at Monterey as he did at Fritzsche, there will be no change in flight activity, and no change in the profit from aircraft operations, if the membership remains constant. If the average monthly flying per member doesn't

change, then the only result of a move will be an increase in the number of members which can be theoretically supported with a given aircraft inventory.

Now we may return to a point mentioned in passing above. It seems likely that the increase in rental rates of the complex aircraft might reduce the demand for these planes. However, as was pointed out earlier in this paper, the demand for club aircraft rental does not appear to be terribly price-sensitive, so long as the hourly rates remain below those available elsewhere. This is particularly true for the complex aircraft which are primarily used in the advanced training curricula. These curricula are almost without exception only undertaken by students who are reimbursed for 90% of their expenses by veterans' benefits, and therefore changes in the rental rates of complex aircraft have little financial impact on the members who fly them.

The reason that the incremental change in flight activity, and therefore profit from aircraft operations, is important is that the funds generated by this increment will be used to recover the estimated $2,000 cost of moving. From a purely financial standpoint, if no additional income can be gained to recover this initial outlay, the move should not be made.

The move to Monterey Airport may be viewed as an investment, and the incremental income from aircraft operations as the cash flows from that investment. The theoretically-correct method to evaluate an investment involves the use of present value techniques, which are thoroughly explained in

Reference [10]. Since the flying club is presumed to have an indefinite life, the present value of funds flows in perpetuity may be approximated by using discount factors for fifty years [Ref. 10]. And since the club can currently earn about 7% on its surplus funds in a savings account, that will be the assumed cost of capital.

Assuming flight activity increases by five percent, either through increased activity by the current membership of 100 members or by gaining additional members, it follows that the average variable profit will increase by a like amount if the increase is spread over all aircraft. Based on the average variable profit calculated for Alternative 3 in the aircraft replacement analysis, the new variable profit per month will increase by $75.64 to $1,588.52 and average monthly profit from aircraft operations will increase by a like amount, since the fixed costs of the aircraft do not change.

This incremental monthly cash flow of $75.64 amounts to $907.68 per year. Discounted at 7% for fifty years (perpetuity), $907.68 has a present value of $12,705.70. Clearly, the move to Monterey is justified at a five percent increase in activity! In fact, an increase in flight activity of only one percent above present levels is sufficient to justify the move. A one percent increase produces an incremental cash flow of $15.13 per month, or $181.55 per year. Discounted for perpetuity at 7%, the present value of this amount is $2,541.28, which is still greater than the $2,000 outlay required.

4. Interpretation

The incremental monthly dollar amounts generated in the preceding analysis were derived from an assumed average monthly profit figure. This monthly profit may or may not be realized, since it was based on several major assumptions about membership flight activity and aircraft inventory. The important point is that only a very small increase in monthly profit (less than \$20) needs to be realized to justify an outlay of of \$2,000 at a cost of capital of 7% and a perpetual investment life.

In summary, a move to Monterey Peninsula Airport offers the possibility of a 10% improvement in flying weather, on an annual basis. If an increase in net income of \$15 or more can be expected to result from such an improvement in operating environment, the move appears to be justified on a financial basis alone. The additional benefits at Monterey of a continuously operating control tower manned by competent FAA personnel, on-airport civilian aircraft repair facilities, and better navigational aids, coupled with the avoidance of the annoyances and possible safety hazards involved in operating from a military facility, simply offer added incentives in favor of a move.

III. CONCLUSIONS

A. GENERAL

The systems analysis approach to decisionmaking is a useful technique, regardless of the magnitude of the problem attacked. It can certainly be effectively applied to the management decisions encountered by a Non-appropriated Fund, whether large or small.

B. SPECIFIC

The following conclusions may be drawn from the analysis of the Fort Ord Flying Club:

1. The four Cessna 150 aircraft presently owned by the club should be replaced by two newer models. This course of action will meet current and expected demand for training type aircraft while speeding the attainment of a sound financial position.

2. The decision rule developed in this thesis for determining appropriate aircraft maintenance actions should be adopted by the club in order to minimize the costs of aircraft operations.

3. If it can be established that a move to the Monterey Peninsula Airport would result in a noticeable increase in flight activity, the move should be undertaken as soon as possible.

APPENDIX A

AIRCRAFT REVENUE AND COST DATA

Cost Assumptions

1. Full time between overhaul (TBO) achieved for all engines.
2. Major overhauls accomplished by a commercial firm.
3. Major overhauls include accessories and propeller.
4. Periodic (100 hr and 50 hr) inspections are performed by club mechanics.
5. Fuel prices reflect military 115/145 @ $.367 per gallon, and commercial 80/87 @ $.538 per gallon. Commercial 80/87 price does not include $.03 per gallon tax.
6. Oil price is for bulk oil (55 gallon drum) @ $.39 per quart. Oil in cans costs $.88 per quart.
7. Normal man-hours of labor required to perform periodic inspections supplied by commercial firm as follows:

Aircraft type	50 hr	100 hr
Cessna 150	3	10
Cessna T-41	5	15
Cessna O-1A	4	14

8. Aircraft tires are unserviceable after approximately 300 hours of normal operations.
9. Depreciation is calculated on a straight-line basis over a service life of 96 months for aircraft. Cessna 150's retail for $14,000.
10. Annual maintenance cost for avionics runs at about 10% of the installed value.
11. Maintenance cost for leased aircraft is billed to lessor.

Cessna 150 N7113S, N3661J, N4380U Revenue/Cost Data

Rental rate per hour		$13.50
Variable costs:		
Fuel (5 GPH x $.538/gal)	$2.69	
Oil (.25 qt/hr x $.39)	.10	
Engine overhaul, 1000 hr TBO ($2,200 ÷ 1,000 hrs)	2.20	
Scheduled inspections:		
100 hr inspection		
Labor (10 x 10 hr/insp x $4.13/hr ÷ 1000)	.41	
Oil changes (10 x 7 qt x $.39/qt ÷ 1000)	.03	
50 hr inspection		
Labor (10 x 3 hrs x $4.13/hr ÷ 1000)	.12	
Oil changes (same as 100 hr)	.03	
Unscheduled maintenance (brake repair, tire changes, etc.)	1.00	
Tires (300 hrs/set ∿ 3 sets/1000 hrs) ($30/tire x 3 tires x 3 sets ÷ 1000)	.27	
Total variable cost per hour		6.85
Variable profit per hour		6.65
Fixed costs per month:		
Avionics (value $800 installed) ($800 x .10 ÷ 12)	6.67	
Depreciation ($14,000 - 7,000) ÷ 3 yrs ÷ 12 months)	194.44	
Insurance	125.00	
Aircraft wash	25.00	
Total fixed cost per month		$351.11

O-1A N5483 Revenue/Cost Data

Rental rate per hour		$13.50
Variable costs:		
Fuel (10 GPH x $.367)	$3.67	
Oil (1 qt/hr x $.39)	.39	
Engine overhaul - 1,800 hr TBO ($4,100 ÷ 1800)	2.28	
Scheduled inspections:		
100 hr inspection:		
Labor (18 x 14 hrs x $4.13 ÷ 1800)	.58	
Oil changes (18 x 9 qt x .39 ÷ 1800)	.04	
50 hr inspections:		
Labor (18 x 4 hrs x $4.13 ÷ 1800)	.17	
Oil changes (same as 100 hr)	.04	
Unscheduled maintenance	1.50	
Tires (300 hrs/set = 6 sets/1800 hrs) ($100/set x 6 sets ÷ 1800 hrs)	.33	
Total variable cost per hour		9.00
Variable profit per hour		$4.50
Fixed costs per month:		
Avionics (value $500 installed) ($500 x .10 ÷ 12)		4.17
Depreciation (on loan from U.S. Army)		0.00
Insurance (on loan from U.S. Army)		0.00
Aircraft wash		25.00
Total fixed cost per month		$29.17

Cherokee 180 N3618R Revenue/Cost Data

Rental rate per hour		$22.00
Variable costs:		
Fuel (10 GPH x $.367)	$3.67	
Oil (1 qt/hr x $.39	.39	
Lease cost per hour	13.00	
Total variable cost		17.06
Variable profit per hour		$4.94

T-41 N17282 Revenue/Cost Data

Rental rate per hour		$15.50
Variable costs:		
Fuel (11 GPH x $.367/gal)	$4.04	
Oil (1 qt/hr x $.39/qt)	.39	
Engine overhaul - 1,000 hr TBO ($4600 ÷ 1000)	4.60	
Scheduled inspections:		
100 hr inspections:		
Labor (10 x 15 hrs/insp x $4.13/hr ÷ 1000)	.62	
Oil changes (10 x 8 qt x $.39 ÷ 1000)	.03	
50 hr inspections:		
Labor (10 x 5 hrs/insp x $4.13 ÷ 1000)	.21	
Oil changes (same as 100 hr)	.03	
Unscheduled maintenance: (brake repair, tire changes, etc.)	1.50	
Tires (300 hrs/set ∿ 3 sets/1000 hrs) ($40/tire x 3 tires x 3 sets ÷ 1000)	.36	
Total variable cost per hour		11.78
Variable profit per hour		3.72
Fixed costs per month:		
Avionics (value $1,000 installed) ($1,000 x 10 ÷ 12)	8.33	
Depreciation (on loan from U.S. Army)	0.00	
Insurance (on loan from U.S. Army)	0.00	
Aircraft wash	25.00	
Total fixed cost per month		$33.33

Commanche 250 N6232P Revenue/Cost Data

Rental rate per hour		$25.00
Variable costs:		
Fuel (14 GPH x $.367)	$5.14	
Oil (1 qt/hr x .39)	.39	
Lease cost per hour	18.00	
Total variable cost		23.53
Variable profit per hour		$1.47

APPENDIX B

Flight Activity Data[1]

	N7113S			N3661J			N4380U			N7247S			N3970		
	R	M	A	R	M	A	R	M	A	R	M	A	R	M	A
1973															
Feb	99.8			95.8		.6	39.7	.9		80.0	1.2		31.8	3.2	
Mar	81.7	.1		77.7	.1	.6	42.9	.2		45.3	3.9		37.0	.4	
Apr	52.1			84.6	.3	.8	56.1	.6		64.3	1.4	.8	40.8		
May				89.3	.6		54.6	.2	.3	10.7			54.0	1.1	1.0
Jun				120.4	1.4		85.2	.8		95.4	1.7		79.8	.3	
Jul				80.1	.8		28.1	.2		96.5	.7		36.6	.7	
Aug				76.5		.8				79.6	.7		69.4		2.2
Sep	49.5	4.5		60.9		2.0				82.1		1.4	52.9	.1	1.7
Oct	86.4	1.5						4.5		73.5		.5	65.7	.3	
Nov	76.2						43.8	3.8		66.8		.5	39.2		
Dec	81.0	.6					41.0	1.0		67.1	.2		32.4		
1974															
Jan	66.2	.6		37.6	5.2		45.9	.3		56.4	.6		25.2	.1	
Feb	75.1			68.6	1.0	.3	20.2	5.5		69.1			23.7	.6	
Mar	70.6	1.0		52.8	.4		22.4	1.0	2.4	66.0	.3		5.6	.5	
Apr	88.2	.4	2.6	68.1	1.8	.5	48.4	.1	1.4	101.1		.9	2.9		
May	75.3	2.2	.7	107.9		4.6	59.0		2.3	103.4	1.3	2.3			
Jun	111.4		.6	91.1	.4		81.5	.2		19.4	.2				
Jul	80.6	.5	1.0	83.2	.5					78.3	.8	1.5			
Aug	66.0			84.5			3.1			74.4					
Sep	76.2	.5		52.5	.4		40.4	.1		57.9	.1				
Oct	78.7			71.6			70.4								
Nov	102.1			51.0	1.3		49.6								
Dec	29.5	.2		19.6	.3	1.2	24.7	.1	.5						

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[1] January 1973 data not available.

Flight Activity Data[1]

	N17282			N1063P			N5974S			N5169P			N5483		
	R	M	A	R	M	A	R	M	A	R	M	A	R	M	A
1973															
Feb	28.5		3.1	3.7		16.2				14.2			25.6	.6	
Mar	22.4		2.3										4.8		
Apr	31.4		2.4	5.4	.9		9.7	2.8		7.7	3.0	1.0	17.6		
May	12.0	1.0		5.2		7.9	11.7	1.1		5.2	.3		8.4	.3	
Jun	18.4		1.5				1.9	1.7		8.7	.3		21.7		
Jul	17.7	1.8					15.9	3.2		19.3			16.3		
Aug	38.8	1.5		28.0		3.5	21.0	1.2			2.3		.8		
Sep	18.4	1.4		6.1		11.3							25.9	.7	
Oct	43.7	2.7		9.7		3.5							20.7		
Nov	29.0		2.9	13.3	3.4					2.1	6.2		13.3		
Dec	22.6	.4	.3	6.4	1.1					34.0	1.5		4.0		
1974															
Jan	45.0	.6		16.1	.9					21.3	4.8		7.3		
Feb	30.4	.5	.4	46.9	.6	2.4	9.0	6.3		22.7	3.0		7.2		
Mar	51.0			49.7	3.3	2.6	30.2	.4	.4	19.3		.9	16.0		
Apr	24.3	4.1		25.7	1.1	1.4	7.7	.5		19.6	1.6		17.2		
May	22.5	.9	4.2	16.9	3.0		2.2	.3	.7	40.7	2.5	1.3		1.1	1.3
Jun	37.2			11.4		.9	43.0	1.7	1.5	3.5			25.3	1.2	
Jul	.6				2.0		21.3			13.9	2.0		16.2		
Aug	27.2			11.5						17.0			8.3		
Sep	12.0		.2							30.8	1.5		1.5		
Oct	14.2	.4								36.4			11.4		
Nov	51.5							.1		22.7		.3	25.6		
Dec	12.7	.2											13.8		

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[1] January 1973 data not available.

Flight Activity Data

	N6577D			N3618R			N6232P		
	R	M	A	R	M	A	R	M	A
1974									
Jul	4.5	2.3							
Aug	13.9								
Sep	4.5	1.0							
Oct	18.0			7.4					
Nov	.5			68.5	.2	1.3	41.1		
Dec	1.5			23.1			45.3		

Column Headings:

Nxxxxx = Aircraft side number

R = Revenue flight hours

M = Maintenance hours

A = Administrative flight hours

Source: Fort Ord Flying Club monthly subsidiary billing documents

APPENDIX C

WEATHER DATA

Fritzsche Army Airfield

Ceiling less than 3,000' and/or visibility less than 3 miles

% annual frequency, local standard time

0900-1200	28%
1200-1500	17%
1500-1800	22%

Source: Reference 5

Fritzsche Army Airfield

Ceiling less than 1,000' and/or visibility less than 2 miles

% annual frequency, local standard time

0900-1200	15%
1200-1500	8%
1500-1800	14%

Source: Reference 5

Monterey Peninsula Airport

Ceiling less than 1,500' and/or visibility less than 3 miles

% annual frequency, local standard time

0900-1200	20.6%
1200-1500	9.9%
1500-1800	14.0%

Source: Reference 11

APPENDIX D

FINANCIAL DATA

Profit & Loss, 1973, by Quarters and as Percent of Income

	QTR 1		QTR 2		QTR 3		QTR 4	
Income								
Aircraft rental	$10,255.10	67	$10,048.75	70	$8,953.45	68	$8,424.45	70
Dues & initiation	4,236.00	28	3,983.00	28	3,411.00	26	3,053.00	26
Ground school, private	417.00	3	291.00	2	282.00	2	198.00	2
Other	461.10	3	13.48	--	468.20	4	295.30	2
Total income	15,369.20	100	14,336.23	100	13,114.65	100	11,970.75	100
Expenses								
Operational								
Gas & oil	2,041.86	13	2,527.86	18	1,942.88	15	1,906.31	16
Maintenance (labor)	2,572.50	17	2,298.65	16	2,312.00	18	1,604.75	13
Repairs (parts & materials)	1,032.05	7	963.85	7	1,249.22	10	546.86	5
Aircraft leases	723.90	5	1,317.60	9	1,626.00	12	1,558.90	13
Depreciation	1,368.90	9	1,372.90	10	1,374.90	10	1,374.90	11
Insurance	792.99	5	759.41	5	840.24	6	840.24	7
Major overhaul	1,779.45	12	1,338.15	9	817.51	6	1,001.85	8
Wash & wax			66.00	--				
Total Operational	10,311.65	67	10,644.42	74	10,162.75	77	8,833.81	74
General & administrative								
Office	212.83	1	685.44	5	357.89	3	591.30	5
Contract manager	2,093.30	14	2,001.20	14	1,825.60	14	1,605.00	13
Interest on notes	334.53	2	334.53	2	334.53	3	242.85	2
Bad debts	21.70	--	258.70	2	250.40	2	323.95	3
Taxes	25.00	--	515.33	4	1,719.75	13	321.75	3
Facility expense	185.00	1	218.87	2	302.89	2	151.85	1
Other	203.85	1	128.11	1	113.91	1	438.66	4
Total General & Admin.	3,076.21	20	4,142.18	29	4,904.97	37	3,675.36	31
Total Expenses	13,387.86	87	14,786.60	103	15,067.72	115	12,509.17	104
Net Profit (Loss)	1,981.34	13	(450.37)	(3)	(1,953.07)	(15)	(538.42)	(4)

FOFC
Sources and Uses of Funds
January 1, 1973 - December 31, 1973

Uses

Increase in Planes and Equipment		$2,647.57
Increase in Prepaid Insurance		137.00
Decrease in Notes Payable (current)		995.85
Decrease in Accounts Payable		156.65
Decrease in Notes Payable (deferred)		3,860.71
Decrease in Membership Deposits		390.00
Decrease in Reserve for Major Overhaul		2,733.70
Total uses		$10,921.48

Sources

Funds Provided by Operations		
Net Income (Loss)	$(960.52)	
Depreciation charged without outlay	5,491.60	$4,531.08
Decrease in Cash on Hand		
Checking	3,726.00	
Savings (Increase)	(55.84)	3,670.16
Decrease in Accounts Receivable		2,720.24
Total sources		$10,921.48

FOFC
Sources and Uses of Funds
First Quarter 1973

Uses		
Increase in cash on hand		
Checking	$4,642.28	
Savings	12.80	$4,655.08
Increase in Planes and Equipment		415.96
Decrease in Accounts Payable		156.65
Decrease in Notes Payable (deferred)		1,297.47
Total uses		$6,525.16
Sources		
Funds provided by Operations		
Net Income	$1,981.34	
Depreciation charged without outlay	1,368.90	3,350.24
Decrease in Accounts Receivable		596.02
Decrease in Prepaid Insurance		792.99
Increase in Membership Deposits		300.00
Increase in reserve for major overhaul		1,485.91
Total sources		$6,525.16

FOFC
Sources and Uses of Funds
Second Quarter 1973

Uses		
Increase in Planes and Equipment		$1,205.03
Increase in Prepaid Insurance		1,489.59
Decrease in Notes Payable (deferred)		1,297.47
Decrease in reserve for major overhaul		741.66
Total uses		$4,733.75
Sources		
Funds provided by Operations		
Net Income (Loss)	$(450.37)	
Depreciation charged without outlay	1,372.90	922.53
Decrease in cash on hand		
Checking	2,535.70	
Savings (increase)	(13.48)	2,522.22
Decrease in Accounts Receivable		1,289.00
Total sources		$4,733.75

FOFC
Sources and Uses of Funds
Third Quarter 1973

Uses		
Increase in Planes and Equipment		$1,183.88
Increase in Prepaid Insurance		280.64
Decrease in Notes Payable (current)		31.70
Decrease in Notes Payable (deferred)		1,265.77
Decrease in Membership Deposits		450.00
Decrease in reserve for major overhaul		2,247.44
Total uses		$5,459.43
Sources		
Funds provided by Operations		
Net Income (Loss)	$(1,953.07)	
Depreciation charged without outlay	1,374.90	$(578.17)
Decrease in cash on hand		
Checking	4,787.19	
Savings (increase)	(14.70)	4,772.49
Decrease in Accounts Receivable		1,265.11
Total sources		$5,459.43

FOFC
Sources and Uses of Funds
Fourth Quarter 1973

Uses		
Increase in Accounts Receivable		$429.89
Decrease in Notes Payable (current)		964.15
Decrease in Membership Deposits		240.00
Decrease in reserve for major overhaul		1,230.51
Total uses		$2,864.55
Sources		
Funds provided by Operations		
Net Income (Loss)	$(538.42)	
Depreciation charged without outlay	1,374.90	$836.48
Decrease in cash on hand		
Checking	1,045.39	
Savings (increase)	(14.86)	1,030.53
Decrease in Planes and Equipment		157.30
Decrease in Prepaid Insurance		840.24
Total sources		$2,864.55

FORT ORD FLYING CLUB

PROFIT AND LOSS
MARCH 1973

INCOME	
Aircraft Rental	$3,010.90
Dues and Initiation	1,209.00
Ground School, Private	297.00
Gas Tax Refund	397.30
V. A. Report Fee	51.00
	4,965.20
EXPENSES	
Office	$103.02
Gas and Oil	638.67
Maintenance	848.25
Repair	126.85
Aircraft Lease	168.30
Contract Manager	658.00
Interest	111.51
Depreciation	456.30
Insurance	264.33
Major Overhaul	524.85
Recruiting	4.00
Janitorial Service	42.00
Miscellaneous	2.25
	$3,948.33
PROFIT FOR MARCH	$1,016.87

FORT ORD FLYING CLUB

ASSETS, MARCH 1973

CURRENT ASSETS				
Cash in Bank:	Checking	$8,457.61		
	Savings	1,293.52		
Total Cash on Hand			$9,751.13	
Accounts Receivable:				
	Current	5,952.58		
	Delinquent Collection	1,883.58		
Total Accounts Receivable			7,836.16	
Total Current Assets				$17,587.29
FIXED ASSETS				
Planes and Equipment			47,310.67	
Less Reserve for Depreciation			17,662.73	
Total Fixed Assets				29,647.94
PREPAID INSURANCE				479.33
TOTAL ASSETS				$47,714.56

FORT ORD FLYING CLUB

LIABILITIES, MARCH 1973

CURRENT LIABILITIES		
Notes Payable		$5,189.88
DEFERRED LIABILITIES		
Notes Payable	$2,563.24	
Membership Deposit (140)	4,200.00	
Major Overhaul (estimate)	5,464.43	
Total Deferred Liabilities		12,227.67
NET WORTH		
Net Worth, Feb. 28, 1973	29,280.14	
Profit for March 1973	1,016.87	
Total Net Worth		30,297.01
TOTAL LIABILITIES AND NET WORTH		$47,714.56

FORT ORD FLYING CLUB

PROFIT AND LOSS

JUNE 1973

INCOME	
Aircraft Rental	$3,916.60
Dues & Initiation	1,343.00
Ground School	111.00
	5,370.60
EXPENSES	
Office	231.74
Gas & Oil	878.62
Maintenance	778.75
Repair	438.31
Aircraft Lease	445.95
Facility & Utility	84.00
Contract Manager	764.60
Interest	111.51
Depreciation	458.30
Insurance	280.08
Major Overhaul	462.10
Recruiting	8.00
Wash & Wax	30.00
Taxes	252.28
Ground School	29.16
Miscellaneous	.95
	5,254.35
PROFIT FOR JUNE	116.25

FORT ORD FLYING CLUB

ASSETS, JUNE 1973

CURRENT ASSETS				
Cash in Bank:	Checking	$5,921.91		
	Savings	1,307.00		
Total Cash in Bank			$7,228.91	
Accounts Receivable:				
	Current	5,238.53		
	Collection	1,308.63		
	Delinquent			
Total Accounts Receivable			6,547.16	
Total Current Assets				$13,776.07
FIXED ASSETS				
Planes & Equipment		48,515.70		
Less: Depreciation		19,035.63		
Total Fixed Assets				29,480.07
PREPAID ACCOUNTS				
Insurance				1,968.92
TOTAL ASSETS				$45,225.06

FORT ORD FLYING CLUB

LIABILITIES, JUNE 1973

CURRENT LIABILITIES		
Notes Payable		$5,189.88
DEFERRED LIABILITIES		
Notes Payable	1,265.77	
Membership Deposits (140)	4,200.00	
Major Overhaul	4,722.77	
Total Deferred Liabilities		10,188.54
NET WORTH		
Net Worth: 31 May 1973	29,730.39	
Profit for June	116.25	
Total Net Worth		29,846.64
TOTAL LIABILITIES AND NET WORTH		45,225.06

FORT ORD FLYING CLUB

PROFIT AND LOSS

SEPTEMBER 1973

INCOME	
Aircraft Rental	$2,612.25
Dues and Initiation	1,145.00
Ground School	162.00
Deposits not refunded	90.00
Total Income	4,009.25
EXPENSES	
Office	139.65
Gas and Oil	782.85
Maintenance	420.00
Repair	760.75
Aircraft Lease	489.75
Facility and Utilities	88.49
V.A. Course Approval Fee	75.00
Contract Manager	594.80
Interest	111.51
Depreciation	458.30
Insurance	280.08
Overhaul	444.30
Taxes	43.50
Miscellaneous	7.00
Total Expenses	4,695.98
LOSS FOR SEPTEMBER 1973	686.73

FORT ORD FLYING CLUB

ASSETS, SEPTEMBER 1973

CURRENT ASSETS				
Cash in bank:	Checking	$1,134.72		
	Savings	1,321.70		
Total cash in bank			$2,456.42	
Accounts Receivable:				
	Current	3,388.17		
	Inactive	(99.55)		
	Delinquent	635.65		
	Collection	1,357.78		
Total Accounts Receivable			5,282.05	
Total Current Assets				$7,738.47
FIXED ASSETS				
Planes and Equipment			49,699.58	
Less Depreciation for Sep 73			20,410.53	
Total Fixed Assets				29,289.05
PREPAID ACCOUNTS				
Insurance				2,249.56
TOTAL ASSETS				$39,277.08

FORT ORD FLYING CLUB

LIABILITIES, SEPTEMBER 1973

CURRENT LIABILITIES		
Notes Payable		$5,158.18
DEFERRED LIABILITIES		
Membership Deposits (125)	$3,750.00	
Major Overhaul	2,475.33	
Total Deferred Liabilities		6,225.33
NET WORTH		
Net Worth, 31 Aug 1973	28,580.30	
Loss for September 1973	686.73	
Total Net Worth		27,893.57
TOTAL LIABILITIES AND NET WORTH		$39,277.08

FORT ORD FLYING CLUB

PROFIT AND LOSS

DECEMBER 1973

INCOME	
Aircraft Rental	$2,862.20
Dues & Initiation	985.00
Ground School	90.00
Miscellaneous	36.24
Total Income	3,973.44
EXPENSES	
Office	138.59
Gas & Oil	427.52
Maintenance	570.00
Repair	99.04
Aircraft Lease	588.05
Contract Manager	442.50
Interest on Notes	65.67
Depreciation	458.30
Insurance	280.08
Overhaul	300.00
Taxes	226.47
Ground School	130.00
Bad Debts (write-off)	323.95
Miscellaneous	75.00
Total Expenses	4,125.17
LOSS FOR DECEMBER	$151.73

FORT ORD FLYING CLUB

ASSETS, DECEMBER 1973

CURRENT ASSETS				
Cash in bank:	Checking	89.33		
	Savings	1,336.56		
Total Cash in Bank			$1,425.89	
Accounts Receivable:				
	Current	5,429.16		
	Inactive	99.55		
	Delinquent	149.40		
	Collection	33.83		
Total Accounts Receivable			5,711.94	
Total Current Assets				$7,137.83
FIXED ASSETS				
Planes and Equipment			49,542.28	
Less Depreciation for Dec 73			21,785.43	
Total Fixed Assets				27,756.85
PREPAID ACCOUNTS				
Insurance				1,409.32
TOTAL ASSETS				$36,304.00

FORT ORD FLYING CLUB

LIABILITIES, DECEMBER 1973

CURRENT LIABILITIES		
Notes Payable		$4,194.03
DEFERRED LIABILITIES		
Membership Deposits (117)	$3,510.00	
Major Overhaul	1,244.82	
Total Deferred Liabilities		4,754.82
NET WORTH		
Net Worth, 30 Nov 1973	27,506.88	
Loss: Loss for Dec 73	151.73	
Total Net Worth		27,355.15
TOTAL WORTH AND LIABILITIES		$36,304.00

Profit & Loss, 1974, by Quarters and as Percent of Income

	QTR 1		QTR 2		QTR 3		QTR 4	
Income								
Aircraft Rental	$13,121.25	77	$13,615.70	76	$10,177.10	71	$12,754.30	77
Dues & initiation	3,558.00	21	3,621.00	20	3,770.00	26	2,928.00	18
Ground school, private	210.00	1	270.00	2	120.00	1	150.00	1
Other	168.00	1	303.04	3	275.02	2	781.68	5
Total Income	17,057.25	100	17,809.74	100	14,342.12	100	16,613.98	100
Expenses								
Operational								
Gas & oil	1,827.11	11	5,291.33	30	3,076.46	21	2,760.06	17
Maintenance (labor)	3,330.80	20	2,370.00	13	3,158.00	22	2,351.80	14
Repairs (parts & materials)	1,289.78	8	3,250.69	18	4,139.43	29	1,248.98	8
Aircraft leases	2,684.35	16	1.680.30	9	828.20	6	2,872.86	17
Depreciation	1,374.90	8	1,407.90	8	1,407.90	10	1,407.90	8
Insurance	840.24	5	662.31	4	527.25	4	672.75	4
Major overhaul	2,107.50	12	1,760.92	10	1,942.50	14	1,027.30	6
Wash & wax	18.00	--					18.00	--
Ground school instructor	390.00	2	390.00	2	310.00	2	180.00	1
Total Operational	13,862.68	82	16,813.45	94	15,389.74	107	12,539.65	75
General & administrative								
Office	565.18	3	666.02	4	1,288.88	9	1,405.99	8
Contract manager	1,532.40	9	1,778.80	10			1,048.20*	6
Interest on notes	97.56	1	195.12	1	228.84	2	191.29	1
Bad debts							38.53	--
Taxes	491.55	3	328.41	2	129.70	1	163.73	1
Facility expense	100.00	1	144.73	1				
Other	75.50	--	422.05	2	267.51	2	521.63	3
Total General & Admin.	2,862.19	17	3,535.13	20	1,914.93	13	3,369.37	20
Total Expenses	16,724.87	98	20,348.58	114	17,304.67	121	15,909.02	96
Net Profit (Loss)	332.38	2	(2,538.84)	(14)	(2,962.55)	(21)	704.96	4

*Chief pilot and part-time manager combined.

FOFC

Sources and Uses of Funds
January 1, 1974 - December 31, 1974

Uses		
Increase in cash on hand:		
Checking	$2,234.57	
Savings	76.86	$2,311.43
Increase in Accounts Receivable		4,334.63
Increase in Miscellaneous Receivables		300.00
Increase in gas and oil inventories		203.55
Increase in resale inventories		216.59
Increase in barrel deposit		15.00
Decrease in Notes Payable		1,934.61
Decrease in Membership Deposits		150.00
Decrease in Reserve for Major Overhaul		217.52
Total uses		$9,683.33
Sources		
Decrease in Planes & Equipment		$1,209.98
Decrease in Prepaid Insurance		288.07
Increase in Accounts Payable		8,347.65
Increase in Unearned Dues		918.00
Funds provided by Operations:		
Net Income (Loss)	$(4,464.05)	
Depreciation charged without outlay	5,030.60	566.55
Adjustments:		
Quarter I	(613.95)	
Quarter II	(2,349.97)	
Profit on sale of glider	468.00	
Quarter III	(1.00)	
Quarter IV		
Credit from Monarch Aviation	850.00	(1,646.92)
Total sources		$9,683.33

FOFC

Sources and Uses of Funds
First Quarter 1974

Uses		
Increase in Cash on Hand:		
Checking	$1,527.80	
Savings	0.00	$1,527.80
Increase in Accounts Receivable		4,393.15
Increase in Gas Inventory		362.50
Increase in Planes and Equipment		452.52
Decrease in Reserve for Major Overhaul		1,240.02
Total uses		$7,975.99
Sources		
Decrease in Prepaid Insurance		$922.75
Increase in Notes Payable (current)		2,756.99
Increase in Accounts Payable		1,788.92
Increase in Unearned Dues		934.00
Increase in Membership Deposits		480.00
Funds Provided by Operations:		
Net Income (Loss)	$ (281.57)	
Depreciation charged without outlay	1,374.90	1,093.33
Total sources		$7,975.99

FOFC

Sources and Uses of Funds
Second Quarter 1974

Uses		
Increase in Accounts Receivable		$2,250.32
Increase in Gas Inventory		35.00
Increase in Prepaid Insurance		1,446.69
Decrease in Notes Payable		716.64
Decrease in Reserve for Major Overhaul		4.80
Total uses		$4,453.45
Sources		
Decrease in Cash on Hand:		
Checking	$425.43	
Savings (increase)	(45.35)	$380.08
Decrease in Planes and Equipment		2,000.00
Increase in Accounts Payable		5,370.28
Increase in Unearned Dues		104.00
Increase in Membership Deposits		180.00
Funds Provided by Operations:		
Net Income (Loss)	(2,538.84)	
Depreciation charged without Outlay	839.90*	
Profit on Sale of Glider	468.00	
Adjustment**	(2,349.97)	(3,580.91)
Total sources		$4,453.45

* Difference ($568.00) between amount shown and depreciation expense listed on Profit & Loss due to adjustment from sale of glider.

** Adjustment due to change from cash to accrual accounting.

FOFC

Sources and Uses of Funds
Third Quarter 1974

Uses		
Increase in Resale Inventory		$ 159.15
Decrease in Notes Payable (current)		1,537.48
Decrease in Unearned Dues		234.00
Decrease in Membership Deposits		540.00
Total uses		$2,470.63
Sources		
Decrease in Cash on Hand:		
Checking	$ 232.21	
Savings	0.00	$ 232.21
Decrease in Accounts Receivable		1,118.65
Decrease in Gas Inventory		37.00
Decrease in Prepaid Insurance		139.25
Increase in Accounts Payable		2,499.17
Funds Provided by Operations:		
Net Income (Loss)	(2,962.55)	
Adjustment	(1.00)	
Depreciation charged without Outlay	1,407.90	(1,555.65)
Total sources		$2,470.63

FOFC

Sources and Uses of Funds
Fourth Quarter 1974

Uses

Increase in Cash on Hand:		
Checking	$1,364.40	
Savings	31.51	$1,395.91
Increase in Resale Inventory		57.44
Increase in Barrel Deposit		15.00
Increase in Planes and Equipment		337.50
Decrease in Notes Payable		2,437.48
Decrease in Accounts Payable		1,310.72
Decrease in Membership Deposits		270.00
Total uses		$5,824.05

Sources

Decrease in Accounts Receivable		$ 890.19
Decrease in Gas Inventory		156.95
Decrease in Prepaid Insurance		672.75
Increase in Unearned Dues		114.00
Increase in Reserve for Major Overhaul		1,027.30
Funds Provided by Operations:		
Net Income	$ 704.96	
Depreciation charged without Outlay	1,407.90	
Credit from Monarch Aviation	850.00	2,962.86
Total sources		$5,824.05

FORT ORD FLYING CLUB

March 1974

PROFIT AND LOSS

INCOME	
Aircraft Rental	$5,077.40
Dues and Initiation	1,083.00
Miscellaneous Income	27.00
Ground School	180.00
Total Income	$6,367.40

EXPENSES	
Office	$ 160.67
Gas and Oil	787.00
Maintenance	1,193.80
Repair	236.40
Aircraft Lease	1,032.90
Contract Manager	563.50
Ground School (Inst.)	130.00
Taxes	177.32
Recruiting	12.00
Aircraft Wash	18.00
Insurance	280.08
Overhaul Est.	1,350.00
Depreciation	458.30
Total Expenses	$6,399.97

LOSS FOR MARCH 1974	$32.57

FORT ORD FLYING CLUB

March 1974

ASSETS

CURRENT ASSETS			
Cash in Bank	$1,617.14 (Checking)		
	1,336.56 (Savings)		
Total Cash in Bank		$2,953.70	
Accounts Receivable:			
Current		8,394.56	
Inactive		26.89	
Delinquent		502.50	
Collection		1,181.18	
Total Accounts Receivable		10,105.09	
Gas Inventory		362.50	
Total Current Assets			$13,421.29
FIXED ASSETS			
Planes and Equipment		49,994.80	
Less: Depreciation		23,160.33	
Total Fixed Assets			26,834.47
PREPAID ACCOUNTS			
Insurance			486.56
TOTAL ASSETS			$40,742.32

FORT ORD FLYING CLUB
March 1974

LIABILITIES

CURRENT LIABILITIES		
Notes Payable	$6,951.02	
Accounts Payable	1,788.92	
Unearned Dues	934.00	
Total Current Liabilities		$9,673.94
DEFERRED LIABILITIES		
Membership Deposits (133)	3,990.00	
Major Overhaul	4.80	
Total Deferred Liabilities		3,994.80
NET WORTH		
Net Worth (adj.) 28 Feb 1974	27,106.15	
Less Profit for March 1974	32.57	
Total Net Worth		27,073.58
TOTAL NET WORTH AND LIABILITIES		$40,742.32

FORT ORD FLYING CLUB
June 1974

PROFIT AND LOSS

INCOME	
Aircraft Rental	$4,349.60
Dues and Initiation	1,190.00
Ground School	180.00
Interest on Savings	45.35
Miscellaneous	162.69
Total Income	$5,927.64
EXPENSES	
Office	$ 145.69
Gas and Oil	1,940.41
Maintenance	1,240.00
Repair	852.42
Aircraft Lease	246.15
Contract Manager	576.60
PP Ground School	130.00
Interest on Notes	48.78
Major Overhaul	428.77
Depreciation	469.30
Insurance	175.75
Taxes	47.32
Recruiting	12.00
Miscellaneous	184.71
Total Expenses	$6,497.90
LOSS FOR JUNE 1974	$570.26

FORT ORD FLYING CLUB

June 1974

ASSETS

CURRENT ASSETS			
Cash in Bank:	$1,191.71 (Checking)		
	1,381.91 (Savings)		
Total Cash on Hand		$2,573.62	
Accounts Receivable:			
	Current	10,103.13	
	Inactive	20.85	
	Delinquent	1,181.18	
	Collection	1,050.25	
Total Accounts Receivable		12,355.41	
Gas Inventory		397.50	
Total Current Assets			$15,326.53
FIXED ASSETS			
Planes and Equipment		47,994.80	
Less: Depreciation		24,000.23	
Total Fixed Assets			23,994.57
PREPAID INSURANCE			1,933.25
TOTAL ASSETS			$41.254.35

FORT ORD FLYING CLUB

June 1974

LIABILITIES

CURRENT LIABILITIES		
Notes Payable	$6,234.38	
Accounts Payable	7,159.20	
Unearned Dues for July	1,038.00	
Total Current Liabilities		$14,431.58
DEFERRED LIABILITIES		
Membership Deposits (139)	4,170.00	
Major Overhaul	0.00	
Total Deferred Liabilities		4,170.00
NET WORTH		
Net Worth, 31 May 1974	25,573.00	
Less: Loss for June 1974	570.26	
Adjustment	2,349.97	
Total Net Worth		22,652.77
TOTAL LIABILITIES AND NET WORTH		$41,254.35

FORT ORD FLYING CLUB

June 1974

Adjustments of these items was made to change from cash to accrual recording.

Office	$178.76
Maintenance	1,243.20
Repair	241.32
Major Overhaul	686.69
Total adjustment to net worth	$2,349.97

FORT ORD FLYING CLUB
September 1974

PROFIT AND LOSS

INCOME	
Aircraft Rental	$3,558.40
Dues and Initiation	1,094.00
Tax Refund	47.96
Miscellaneous	86.54
Total Income	4,786.90
EXPENSES	
Office	415.92
Gas and Oil	1,032.96
Maintenance	908.50
Repair	733.26
Aircraft Lease	292.60
Ground School	90.00
Interest on Notes	48.78
Major Overhaul	984.75
Depreciation	469.30
Insurance	175.75
Resale Items	80.74
Taxes	49.02
Miscellaneous	30.20
Total Expenses	5,311.78
LOSS FOR SEPTEMBER 1974	$524.88

FORT ORD FLYING CLUB

September 1974

ASSETS

CURRENT ASSETS				
Cash in Bank:	Checking	$ 959.50		
	Savings	1,381.91		
Total Cash on Hand			$2,341.41	
Accounts Receivable:				
	Current	9,281.33		
	Inactive	19.79		
	Delinquent	1,185.64		
	Collection	750.00		
Total Accounts Receivable			11,236.76	
Gas Inventory			360.50	
Total Current Assets				$14,097.82
FIXED ASSETS				
Planes and Equipment			47,994.80	
Less: Depreciation			25,408.13	
Total Fixed Assets				22,586.67
PREPAID ACCOUNTS				
Insurance				1,794.00
TOTAL ASSETS				$38,478.49

FORT ORD FLYING CLUB

September 1974

LIABILITIES AND NET WORTH

CURRENT LIABILITIES		
Notes Payable	$4,696.90	
Accounts Payable	9,658.37	
Unearned Dues for October	804.00	
Total Current Liabilities		$15,159.27
DEFERRED LIABILITIES		
Membership Deposits (121)		3,630.00
NET WORTH		
Net Worth 31 August 1974	20,214.10	
Less: Loss for Sep 1974	524.88	
Total Net Worth		19,689.22
TOTAL LIABILITIES AND NET WORTH		$38,478.49

FORT ORD FLYING CLUB
December 1974
PROFIT AND LOSS

INCOME	
Aircraft Rental	$2,708.80
Dues and Initiation	940.00
A/C delivery to Ft. Carson Club	300.00
Resale	11.65
Chief Pilot	71.50
Interest on Savings	15.85
	4,047.80
EXPENSES	
Office	246.41
Gas and Oil	888.89
Maintenance	360.30
Repair	127.39
Aircraft Lease	1,038.66
Manager	109.10
Chief Pilot	70.60
Interest	57.99
Insurance	224.25
Depreciation	469.30
Major Overhaul	156.45
Taxes	50.89
Advertising	7.98
Dept. of Education (VA Approval)	150.00
Resale Items	11.65
Miscellaneous	.89
Collection Fee	12.50
	3,983.25
PROFIT FOR DECEMBER 1974	64.55

FORT ORD FLYING CLUB

December 1974

ASSETS

CURRENT ASSETS				
Cash in Bank:	$2,323.90	(checking)		
	1,413.42	(savings)		
Total Cash on Hand			$3,737.32	
Accounts Receivable:				
Current	3,760.96			
Inactive	18.10			
Delinquent	5,167.40			
Collection	1,100.11			
Total Accounts Receivable			10,046.57	
Miscellaneous Receivables			300.00	
Gas & Oil E.O.M Inventory			203.55	
Resale Inventory			216.59	
Barrel Deposit			15.00	
Total Current Assets				$14,519.03
FIXED ASSETS				
Planes and Equipment			48,332.30	
Less: Depreciation			26,816.03	
Total Fixed Assets				21,516.27
PREPAID ACCOUNTS				
Insurance				1,121.25
TOTAL ASSETS				$37,156.55

FORT ORD FLYING CLUB
December 1974

LIABILITIES AND NET WORTH

CURRENT LIABILITIES		
Notes Payable	$2,259.42	
Accounts Payable	8,347.65	
Unearned Dues for Jan 1975	918.00	
Total Current Liabilities		$11,525.07
DEFERRED LIABILITIES		
Membership Deposits (112)	3,360.00	
Major Overhaul	1,027.30	
Total Deferred Liabilities		4,387.30
NET WORTH		
Net Worth, 31 Nov 1974	20,329.63	
Plus: Parts credit from Monarch Aviation	850.00	
Plus: Profit for Dec 1974	64.55	
Total Net Worth		21,244.18
TOTAL LIABILITIES AND NET WORTH		$37,156.55

APPENDIX E

FORT ORD FLYING CLUB
ACTIVELY FLYING AND VA MEMBERSHIP
February 1973 - November 1974

Year	Month	Actively Flying Members	VA Members
1973	February	78	10
	March	80	8
	April	83	9
	May	83	10
	June	77	11
	July	74	10
	August	71	7
	September	73	7
	October	71	10
	November	70	12
	December	76	15
1974	January	86	17
	February	93	16
	March	97	16
	April	92	16*
	May	102	16*
	June	107	19*
	July	103	12
	August	99	15
	September	91	12
	October	89	13
	November	85	13

* Estimated

Source: Billing records of the Fort Ord Flying Club

LIST OF REFERENCES

1. "NAF Activities Under Fire," Air Force Times, v- 33:24, 20 June 197 .

2. Towle, B., "The NAF Hassle," Air Force Times, v. 33:13 20 June 197 .

3. Fisher, G.H., Cost Considerations in Systems Analysis, pp. 6-11, Elsevier, 1971.

4. Interview, LCDR Bryan E. Bradford, USN (Ret'd), accountant, Fort Ord Flying Club, 26 January 1975.

5. U.S. Air Force Environmental Technical Applications Center, Worldwide Airfield Climatic Data, Fort Ord/Fritzsche AAF, Monterey, California, March 1972.

6. Hoel, P.G., and Jessen, R.J., Basic Statistics for Business and Economics, pp. 237-266, Wiley, 1971.

7. Bolch, B.W., and Huang, C.J., Multivariate Statistical Methods for Business and Economics, pp. 105-207, Prentice-Hall, 1974.

8. Hillier, F.S. and Lieberman, G.J., Introduction to Operations Research, pp. 127-171, Holden-Day, 1967.

9. Interview, Mr. Fred R. Fuller, Assistant Manager, Monterey Peninsula Airport, 29 November 1974.

10. Hunt, P., Williams, C.M., and Donaldson, G., Basic Business Finance, pp. 145-202, Irwin, 1971.

11. U.S. Air Force Environmental Technical Applications Center, Worldwide Airfield Climatic Data, vol. III, part 1, p. 94, May 1969.

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